MEETINGS

October 24-25—AIME, petroleum division annual western section meeting, Ambassador Hotel, Los Angeles.

October 24-25—American Association of Petroleum Geologists, midyear meeting, Buena Vista Hotel, Biloxi, Miss.

October 28-30—Independent Petroleum Association of America, annual meeting, Fort Worth, Texas.

October 28-30—Midwest Gas Association and Iowa College gas school and conference, Ames, Iowa.

November 1-2—Secondary Recovery Conference, Pennsylvania State College.

November 2—Nomads, Fall Festival, Mayfair Hotel, Los Angeles.

November 7-8—Society of Automotive Engineers, national fuels and lubricants meeting, Mayo Hotel, Tulsa.

November 11—Nomads, Old College Inn, Houston, Texas.

November 11-14—API, annual meeting, Stevens Hotel, Chicago.

November 13—Nomads, Mayfair Hotel, Los Angeles, California.

November 18-22—AIME, iron and steel division, annual fall meeting, Atlantic City, N. J.

November 18-22—American Welding Society, annual meeting, Atlantic City, New Jersey.

November 21-22—Mid-Southeastern Gas Association, Raleigh, North Carolina.

November 21-23—Rocky Mountain Oil and Gas Association, annual meeting, Shirley-Savoy Hotel, Denver, Colorado.

December 2-6—American Society of Mechanical Engineers, New York.

December 4—New Mexico Oil and Gas Association, annual meeting, Artesia.

December 9—Nomads, Old College Inn, Houston, Texas.

December 9-11—Interstate Oil Compact Commission, Adolphus Hotel, Dallas, Texas.

January 6-10—Society of Automotive Engineers, annual meeting and engineering display, Book-Cadillac Hotel, Detroit, Michigan.

March, 1947—First South American Petroleum Congress (ISAP), Lima, Peru.

March 17-22—AIME, 75th annual meeting and world conference on mineral resources, Waldorf-Astoria Hotel, New York.

April 7-10—National Association of Corrosion Engineers, annual convention, Palmer House, Chicago.

April 16-18—API Eastern District production meeting, William Penn Hotel, Philadelphia, Pennsylvania.

April 23-25—Natural Gasoline Association of America, annual meeting, Baker Hotel, Dallas, Texas.

May 15-16—API Pacific Coast District production meeting, Biltmore Hotel, Los Angeles, Calif.

May 22-23—API Mid-Continent District production meeting, Herring Hotel, Amarillo, Texas.

THE Petroleum Engineer

October, 1946
Vol. XVIII No. 1

A MAGAZINE OF METHODS FOR OPERATING MEN

FOREIGN SECTION

Are We Importing Too Much Oil?—*H. J. Struth* ... 52
Technology Factor in S. A. Oil Development—*Wallace A. Sawdon* ... 57
Bonanza Fields of Saudi Arabia ... 61
Canadian Developments—1946—*Floyd K. Beach* ... 67
Oil Search at Pyramids ... 78
European Shale-Treating Practice—*Ernestine Adams* ... 82
Development of Amana Field in Venezuela—*Rex Watson* ... 93
China—Its Future in Petroleum—*Arthur D. Small* ... 98
Japanese Petroleum Industry—*Jan G. Schaafsma* ... 110
Exploring for Oil in Radar Ship ... 114
Aromatic Hydrocarbons From Petroleum—The Catarole Process ... 119
Petroleum Highlights in Venezuela—*Harry H. Power* ... 124
Canada Has Intense Exploration Program—*Richard Sneddon* ... 145
Geophysical Operations in Kuwait—*P. H. Boots and Alexander H. McKee* ... 155
Union Explores Paraguayan Chaco—*Richard Sneddon* ... 166
Crossing the Wangpoo at Shanghai—*Frank E. Hangs* ... 174
Estimates of Russian Oil Resources—*Ernestine Adams* ... 178
Socony-Vacuum European Refinery Operations ... 184
Company to Explore Philippine Holdings ... 184
Possibilities and Problems of Drilling Beyond the Continental Shelf—*Henry Emmett Gross* ... 186

DRILLING AND PRODUCTION

Engineering Developments in S. W. Texas—*John W. Crutchfield and Horton T. Pruett* ... 208
Electrical Methods in Oil Exploration—*V. G. Gabriel* ... 216
New Rotary Tool Is Used to Keep Drill Pipe Free—*K. Marshall Fagin* ... 272

REFINING AND NATURAL GASOLINE MANUFACTURE

Trend in Refining Training—*Homer T. Fort* ... 194
Physics Research Division Broadens Its Activities (Part 2, Conclusion)—*G. M. Webb, W. S. Gallaway, M. J. Murray, C. H. Ehrhardt* ... 224
Vapor Lock in Aircraft Engines—*Wallace A. Craig* ... 278

OIL AND TRANSPORTATION

Economical Alignment for Pipe Lines—*Peyton Bryan* ... 212
Stanolind Increases Capacity—*Frank H. Love* ... 267

GENERAL

Oil Accounting (Part 2)—*Jack D. Farnan* ... 204

REGULAR FEATURES

Course of Oil ... 12
Scanning Washington's Oil Horizon ... 14
National Petroleum Situation ... 16-17
Highlights in Oildom ... 18
Major Oil Field Activities ... 20
Major Refining Activities ... 22
Major Pipe Line Activities ... 24
Machinery and Equipment ... 235-246
Trade Literature ... 248
The Petroleum Engineer's Continuous Tables (Installment No. 112) ... 251-266
Running Tour With Men in the Industry ... 286-289
Laugh With Barney ... 290
Pacific Personalities ... 310
Book Reviews ... 313

THE PETROLEUM ENGINEER PUBLISHING COMPANY

Irwin-Keasler Building, Dallas 1, Texas **Phone: Central-4571**

EXECUTIVE—W. L. LOVE, *president.* W. T. BRYAN, *general manager and treasurer.*

EDITORIAL—K. C. SCLATER, *vice president and editor.* FRANK H. LOVE, *managing editor*
K. MARSHALL FAGIN, *field editor* ERNESTINE ADAMS, *associate editor*
RICHARD SNEDDON, *Pacific coast editor,* 653 West Glenoaks, Glendale 2, Calif., Citrus 2-8446.

ADVERTISING—T. J. CROWLEY, *vice president and advertising manager.*
New York—JOE B. WOODS, 52 Vanderbilt Avenue, New York 17, N. Y., MUrray Hill 4-1880.
Chicago—E. V. PERKINS, 22 West Maple Street, Chicago 10, Illinois, SUPerior 1823.
Los Angeles—R. C. WIPPERMAN, 1220 South Maple Ave., Los Angeles, California, PRospect 9093.

CIRCULATION—C. R. BARRETT, *circulation manager.*

Copyright 1946 by The Petroleum Engineer Publishing Company

Articles in The Petroleum Engineer are indexed by Industrial Arts Index

A. B. C. SUBSCRIPTION: 1 year, $2 — 2 years, $3 A. B. P.

MEETINGS

October 24-25—AIME, petroleum division annual western section meeting, Ambassador Hotel, Los Angeles.

October 24-25—American Association of Petroleum Geologists, midyear meeting, Buena Vista Hotel, Biloxi, Miss.

October 28-30—Independent Petroleum Association of America, annual meeting, Fort Worth, Texas.

October 28-30—Midwest Gas Association and Iowa College gas school and conference, Ames, Iowa.

November 1-2—Secondary Recovery Conference, Pennsylvania State College.

November 2—Nomads, Fall Festival, Mayfair Hotel, Los Angeles.

November 7-8—Society of Automotive Engineers, national fuels and lubricants meeting, Mayo Hotel, Tulsa.

November 11—Nomads, Old College Inn, Houston, Texas.

November 11-14—API, annual meeting, Stevens Hotel, Chicago.

November 13—Nomads, Mayfair Hotel, Los Angeles, California.

November 18-22—AIME, iron and steel division, annual fall meeting, Atlantic City, N. J.

November 18-22—American Welding Society, annual meeting, Atlantic City, New Jersey.

November 21-22—Mid-Southeastern Gas Association, Raleigh, North Carolina.

November 21-23—Rocky Mountain Oil and Gas Association, annual meeting, Shirley-Savoy Hotel, Denver, Colorado.

December 2-6—American Society of Mechanical Engineers, New York.

December 4—New Mexico Oil and Gas Association, annual meeting, Artesia.

December 9—Nomads, Old College Inn, Houston, Texas.

December 9-11—Interstate Oil Compact Commission, Adolphus Hotel, Dallas, Texas.

January 6-10—Society of Automotive Engineers, annual meeting and engineering display, Book-Cadillac Hotel, Detroit, Michigan.

March, 1947—First South American Petroleum Congress (ISAP), Lima, Peru.

March 17-22—AIME, 75th annual meeting and world conference on mineral resources, Waldorf-Astoria Hotel, New York.

April 7-10—National Association of Corrosion Engineers, annual convention, Palmer House, Chicago.

April 16-18—API Eastern District production meeting, William Penn Hotel, Philadelphia, Pennsylvania.

April 23-25—Natural Gasoline Association of America, annual meeting, Baker Hotel, Dallas, Texas.

May 15-16—API Pacific Coast District production meeting, Biltmore Hotel, Los Angeles, Calif.

May 22-23—API Mid-Continent District production meeting, Herring Hotel, Amarillo, Texas.

THE Petroleum Engineer

October, 1946
Vol. XVIII No. 1

A MAGAZINE OF METHODS FOR OPERATING MEN

FOREIGN SECTION

Are We Importing Too Much Oil?—*H. J. Struth* ... 52
Technology Factor in S. A. Oil Development—*Wallace A. Sawdon* ... 57
Bonanza Fields of Saudi Arabia ... 61
Canadian Developments—1946—*Floyd K. Beach* ... 67
Oil Search at Pyramids ... 78
European Shale-Treating Practice—*Ernestine Adams* ... 82
Development of Amana Field in Venezuela—*Rex Watson* ... 93
China—Its Future in Petroleum—*Arthur D. Small* ... 98
Japanese Petroleum Industry—*Jan G. Schaafsma* ... 110
Exploring for Oil in Radar Ship ... 114
Aromatic Hydrocarbons From Petroleum—The Catarole Process ... 119
Petroleum Highlights in Venezuela—*Harry H. Power* ... 124
Canada Has Intense Exploration Program—*Richard Sneddon* ... 145
Geophysical Operations in Kuwait—*P. H. Boots and Alexander H. McKee* ... 155
Union Explores Paraguayan Chaco—*Richard Sneddon* ... 166
Crossing the Wangpoo at Shanghai—*Frank E. Hangs* ... 174
Estimates of Russian Oil Resources—*Ernestine Adams* ... 178
Socony-Vacuum European Refinery Operations ... 184
Company to Explore Philippine Holdings ... 184
Possibilities and Problems of Drilling Beyond the Continental Shelf—*Henry Emmett Gross* ... 186

DRILLING AND PRODUCTION

Engineering Developments in S. W. Texas—*John W. Crutchfield and Horton T. Pruett* ... 208
Electrical Methods in Oil Exploration—*V. G. Gabriel* ... 216
New Rotary Tool Is Used to Keep Drill Pipe Free—*K. Marshall Fagin* ... 272

REFINING AND NATURAL GASOLINE MANUFACTURE

Trend in Refining Training—*Homer T. Fort* ... 194
Physics Research Division Broadens Its Activities (Part 2, Conclusion)—*G. M. Webb, W. S. Gallaway, M. J. Murray, C. H. Ehrhardt* ... 224
Vapor Lock in Aircraft Engines—*Wallace A. Craig* ... 278

OIL AND TRANSPORTATION

Economical Alignment for Pipe Lines—*Peyton Bryan* ... 212
Stanolind Increases Capacity—*Frank H. Love* ... 267

GENERAL

Oil Accounting (Part 2)—*Jack D. Farnan* ... 204

REGULAR FEATURES

Course of Oil ... 12
Scanning Washington's Oil Horizon ... 14
National Petroleum Situation ... 16-17
Highlights in Oildom ... 18
Major Oil Field Activities ... 20
Major Refining Activities ... 22
Major Pipe Line Activities ... 24
Machinery and Equipment ... 235-246
Trade Literature ... 248
The Petroleum Engineer's Continuous Tables (Installment No. 112) ... 251-266
Running Tour With Men in the Industry ... 286-289
Laugh With Barney ... 290
Pacific Personalities ... 310
Book Reviews ... 313

THE PETROLEUM ENGINEER PUBLISHING COMPANY

Irwin-Keasler Building, Dallas 1, Texas **Phone: Central-4571**

EXECUTIVE—W. L. LOVE, *president.* W. T. BRYAN, *general manager and treasurer.*

EDITORIAL—K. C. SCLATER, *vice president and editor.* FRANK H. LOVE, *managing editor*
K. MARSHALL FAGIN, *field editor* ERNESTINE ADAMS, *associate editor*
RICHARD SNEDDON, *Pacific coast editor,* 653 West Glenoaks, Glendale 2, Calif., Citrus 2-8446.

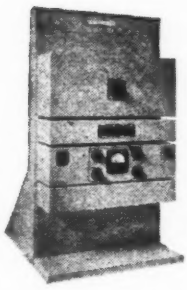
ADVERTISING—T. J. CROWLEY, *vice president and advertising manager.*
New York—JOE B. WOODS, 52 Vanderbilt Avenue, New York 17, N. Y., MUrray Hill 4-1880.
Chicago—E. V. PERKINS, 22 West Maple Street, Chicago 10, Illinois, SUPerior 1823.
Los Angeles—R. C. WIPPERMAN, 1220 South Maple Ave., Los Angeles, California, PRospect 9093.

CIRCULATION—C. R. BARRETT, *circulation manager.*

Copyright 1946 by The Petroleum Engineer Publishing Company

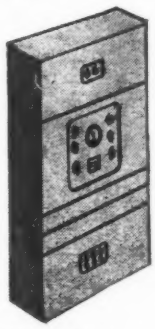
Articles in The Petroleum Engineer are indexed by Industrial Arts Index

A. B. C. SUBSCRIPTION: 1 year, $2 — 2 years, $3 A. B. P.



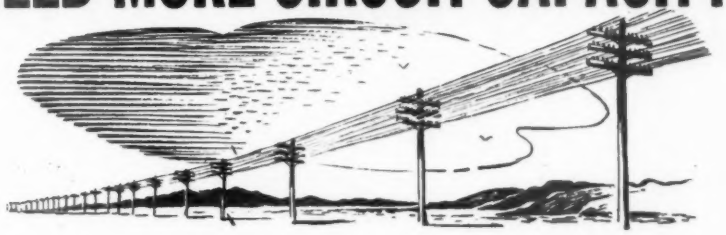
FTR 9-A-1
Single-Channel Carrier
Gives one additional speech channel over existing open-wire lines. Normal range—up to 300 miles without repeaters.

FTR 9-B-1
Three-Channel Carrier
Gives three additional speech channels over existing open-wire lines. Normal range — up to 200 miles without repeaters.



FTR 9-C-1
Speech-Plus-Duplex Telegraph Carrier
Gives duplex teleprinter channel over telephone or radio circuit (two over carrier telephone channel) retaining speech facilities — up to 100 words per minute — distortion minimized by frequency modulation.

NEED MORE CIRCUIT CAPACITY?



You Can Get from
1 to 18 EXTRA CHANNELS
ON EXISTING TELEPHONE LINES
...with Federal Carrier Systems

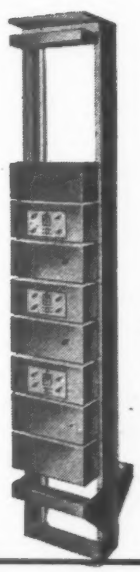
Federal's complete line of Carrier Telephone Systems offers you 5 ways to increase circuit capacity, without the expense and delay of new line construction.

Each type of carrier has been engineered for a particular type of service—but all are of Federal quality in every detail. That means FTR *features:* Hermetically-sealed units, compact construction, flexibility of operation, ease of installation, and above all—service-proved dependability, backed by Federal's 37 years of experience in designing and manufacturing superior telephone and electronic equipment.

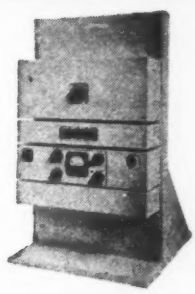
AVAILABLE NOW!

Federal's expanded manufacturing facilities have boosted production so that prompt shipments can be made. For complete information, write to Dept. H540.

THIS EQUIPMENT WILL BE ON DISPLAY in the industrial exhibitions at the Stevens Hotel, Chicago, Oct. 14, 15, and 16; and at the Hotel Statler, Detroit, Nov. 19, 20, and 21.



FTR 9-E-1
Multi-Channel Carrier
Provides from 1 to 18 voice-frequency telegraph channels — up to 100 words a minute — over telephone facilities.



FTR 9-F-1
Single-Channel Carrier
Second Story
Physically and operatively similar to 9-A-1 but operates at higher frequencies. Occupies spectrum above normal single channel systems. Normal range up to 200 miles without repeaters.

Federal Telephone and Radio Corporation

In Canada:—Federal Electric Manufacturing Company, Ltd., Montreal
Export Distributor:—International Standard Electric Corporation, 67 Broad St., N. Y. C.

Newark 1, New Jersey

The Course of Oil

by K. C. SCLATER

DEVELOPING PETROLEUM RESOURCES

All countries now recognize the importance of natural petroleum resources as a national asset. Petroleum has therefore become a leading topic in almost any discussion of world affairs. As an industry, petroleum has had its greatest growth and development in the United States under a highly competitive system of private enterprise. The trend in the development of petroleum resources in many countries outside the United States is toward nationalization of the industry. In this connection, Joseph E. Pogue, speaking on the development of petroleum resources at the Princeton University Bicentennial early this month, made some pertinent observations that merit attention:

"Petroleum has demonstrated the extent to which technology can serve to multiply a known resource reserve, while the progress of science in rearranging the structure of the molecule suggests that it *is* technology, not the apparent resource inventory, which is the controlling factor. If this is true, then the need is for a setting and procedures conducive to the optimum development of technology. This is the paramount issue so far as resources are concerned. It may be doubted if any form of centralized effort can promote technology to the same degree as a series of vigorous, competing enterprises. The latter has the advantage of multiple effort and diverse approach.

"In the realm of efficient extraction of petroleum from the ground, the petroleum industry has achieved notable progress. This has been accomplished with the aid of state conservation laws, since the small leaseholds prevailing in the United States necessitate off-set drilling and hasty withdrawals of the oil if not countered by a restraining influence. In the early period of the industry's development the significance of the rate of production per well was not understood, but in the last two decades the wide-open flow of oil wells has been found to be inefficient and has been replaced by a system of proration under the supervision of the states, but with the full cooperation of the industry, whereby oil wells are held to or below the rates of flow which permit the optimum utilization of the reservoir energy. Thus practical conservation has been achieved together with some measure of stabilization of the industry, without unduly impairing the freedom of individual action so necessary for multiple effort.

"The achievement of optimum well-flow under competitive conditions is administered by a system of decentralized regulations which would appear to represent an effective and practical method of government-industry cooperation which merits wider understanding. The ingredients of this system are: (1) State conservation laws administered by state regulatory bodies; (2) an Interstate Oil Compact representing a treaty between the states which operates as a coordinating influence but without powers of enforcement; and (3) estimates of demand prepared by the federal Bureau of Mines and submitted to the states as guides for production schedules, but with no compulsion as to their acceptance. Despite its looseness of structure, this system has worked successfully for many years. It illustrates how conservation has been achieved by voluntary cooperation without regimentation. The same principle was invoked during the war period in the organization of the Petroleum Industry for War and its advisory group, the Petroleum Industry War Council.

"Finally, the American petroleum industry has been instrumental in promoting oil developments in all parts of the world and has played a major role in the international oil trade. As a result of experience in the United States in the field of conservation and interstate relationships, it has been suggested that the creation of an International Oil Compact for the coordination of the policies of producing and consuming nations would be an effective way to facilitate the wider and more orderly production and consumption of oil amongst all nations. A first step towards this end has already been taken in the negotiation of an Anglo-American Petroleum Agreement which awaits ratification by the United States Senate to become effective. This instrument is patterned after the system of coordination long in successful use in the United States, and constitutes an interim step toward a multilateral agreement open to adherence by all nations. Such a program, supported by a constructive national oil policy, would constitute machinery for the solution of oil problems in the international field and could contribute to a vigorous development of the world's oil resources in a manner conducive to economic stability and world peace. It is noteworthy that the type of enterprise which has taken the lead in developing the world's oil resources has also made important contributions toward formulating policies which this country and others might adopt in the interest of national and international progress.

"In conclusion, to all interested in the development of natural resources whether in the United States or the world at large, the organization, procedure, and administrative forms developed in connection with the American petroleum industry may be commended as offering ideas for the solution of natural resource problems in general."

Mission SUPER-SURFACED*
PISTON RODS
● Last twice as long as File Hard Rods under normal conditions.
● Last up to four times as long as File Hard Rods under corrosive conditions.
The longer life of Mission Super-Surfaced* Piston Rods has been conclusively proved by majors, independents, and drilling contractors in every oil country.
* Trade Mark, Registered U. S. Patent Office
Sold by Supply Stores-everywhere
UNCONDITIONAL GUARANTEE
The Mission Manufacturing Company unconditionally guarantees MISSION Super-Surfaced* PISTON RODS to be perfect in workmanship and material and that, when used with Mission Pistons of the proper taper and Mission Gland Packings, they will neither cut out between rods and pistons nor break in service causing damage to pump against which we guarantee full coverage.
Mission MANUFACTURING CO.
HOUSTON TEXAS
Export Office: Room 1636 30 Rockefeller Plaza New York 20, N. Y.

Scanning WASHINGTON'S OIL HORIZON

By MILBURN PETTY

WASHINGTON—Independent producers are still seeking a forum for discussion of a national oil import policy with all parties concerned, now that the State Department has ducked the question.

Domestic producers were disappointed when the State Department turned thumbs down on the proposal by Russell B. Brown, general counsel for Independent Petroleum Association of America, for a conference of oil producers, importers, military authorities, and government officials on imports.

State Department took the position that it has not been decided yet whether petroleum will be among the commodities listed for tariff-cut discussions in negotiating several new reciprocal trade agreements. Should petroleum be included in such list, the IPAA and others interested will have a chance to protest and be given a hearing by the Committee on Reciprocity Information, State officials said.

But the IPAA contends that this would be too late. All sides of the important question, they insist, should be discussed thoroughly *before* any decision is reached on whether petroleum should be listed for tariff-cut negotiations.

It may turn out that the newly-organized National Petroleum Council will be the arena for debate on oil imports. Military authorities have suggested that a subcommittee of the Council be set up to consider sources of military oil supplies, covering accessible foreign areas as well as domestic. This ties in with the suggestion by Ralph K. Davies, acting director of Interior Department's new Oil and Gas Division, that NPC establish a subcommittee to study and report on the adequacy of domestic reserves, access to foreign reserves, and governmental action needed to insure an adequate supply for the United States.

The military's attitude boils down to this: There should be an all-out effort by both the government and industry to find new oil reserves in this country and—as a second string to the bow—the government should encourage the development of American-owned holdings in accessible foreign areas, even to the extent of letting down the bars on more imports.

● **NATIONAL COUNCIL.** Now that the National Petroleum Council, industry advisory group proposed by President Truman, has been formally organized, the next step is to elect a permanent chairman. A nominating committee is to report back at the next meeting. Walter Hallanan (Plymouth Oil), the temporary chairman, probably will be chosen, if he can be persuaded to accept. If not, there is considerable sentiment for Ralph Davies to take the post.

Meanwhile, Interior's new Oil and Gas Division, companion to the Council under Truman's May 3 letter, is understaffed and with no permanent director named at this writing. Also, budget officials are preparing to use the pruning knife on OGD's request for funds.

● **API SUIT.** Department of Justice has set the stage for dismissal of the API-Mother Hubbard antitrust suit—but nothing is likely to be done about it until after the November elections. The tip-off was the DJ's decision to seek a postponement of the October 15 deadline for the government's reply to Sun Oil Company's answer in this omnibus suit, pending since 1940. When Attorney General Tom Clark returned from Europe he found that Antitrust Chief Wendell Berge had ordered a nationwide investigation of oil price increase—especially on crude—since OPA controls were removed, saying many complaints had been received "both as to the extent of the increases and as to the uniform and simultaneous action of the oil companies." It has been long expected that when and if the API case is dismissed the DJ will announce several new proceedings at the same time. Thus, the stage is set for a post-election announcement.

● **PUBLIC LANDS.** Interior Department is likely to adopt nearly all of the changes in the proposed new oil and gas leasing regulations suggested at the Denver meeting, September 30 and October 1, between Interior officials and industry representatives. Mostly the changes suggested were for clarification. Final draft of the regulations is expected to be ready early in November.

● **ARABIAN PIPE LINE.** Military authorities are inclined to favor entering into a long-range contract with the Cal-Tex interests to take a substantial part of the output of the refinery proposed for eastern end of the Mediterranean—but they wouldn't dare make such a commitment without informal approval, at least, from the appropriate congressional committees. Decision on this point may be an important factor in deciding when the Trans-Arabian pipe line will be built.

● **TANKERS.** U. S. Maritime Commission is likely to have many government-owned tankers still unsold when Congress meets in January. So, the Commission will seek permission to bareboat charter them to private interests for long terms. This kills two birds at once. First, it gets the government out of the tanker business; second, it provides the industry with enough tankers to voyage charter them to the Navy for overseas shipments to our armed forces. (Because of unsettled world conditions, military authorities want to control such tanker movements—or have the authority to do so—until June 30, 1948.)

● **ROYALTY OIL.** Small refiners have been slow to file requests for the purchase of government royalty oil from public lands under the O'Mahoney Law giving them preference. Within a few weeks, however, Interior probably will announce that it is taking royalty oil in kind from several California and Wyoming fields including Kettleman Hills North Dome, 2000 bbl. per day, Oak Canyon, 200 bbl. per day, Salt Creek, 1300 bbl. per day, and Lance Creek, 300 bbl. per day. Bids will be called for with preference to be given to refiners without an adequate crude supply of their own.

● **TEL.** The lead situation generally shows no sign of improving for some months to come. Ethyl Corporation expects to scrape by the final quarter without reducing tetraethyl lead allocations to refiners by drawing heavily on its inventories, which are already greatly depleted. Pressure is being put on Civilian Production Administration to ease up on octane ceilings for catalytically-cracked gasoline containing only a small amount of lead—and not all of the pressure is coming from War Assets Administration, which would like to create demand for its surplus 100-octane plants. The avgas plants are moving very slowly. But there is a quickening of interest among foreign buyers, which may force the hand of U. S. refiners.

● **AVGAS PLANT.** A new pattern for trying out the wartime-built "cat" crackers under postwar conditions has been worked out between WAA and Ashland Oil and Refining Company on the plant Ashland operated during the war. Ashland agrees to make certain changes, estimated to cost between $50,000 and $100,000, in the TCC unit in lieu of rental payments for six months, with an option to buy later at a price to be determined.

● **ELK HILLS.** Navy Secretary Forrestal probably will give his blessing to California Standard's requested modification in the contract for developing Elk Hills Naval Petroleum Reserve so that the company will have to bear no more than its share of the "readiness cost." Standard sought the change after the Navy reduced the allowable production from 15,000 bbl. per day to 8,450 bbl. per day. (Standard says it is buying between 42 and 45 per cent of its crude requirements now.)

● **POSTSCRIPTS.** UNRRA has completed arrangements for reopening four Italian refineries, with crude requirements estimated at 2,700,000 bbl. over the next five months . . . Two former PAW officials, George Armistead and Harry King, are trying to help WAA get rid of its avgas plants . . . Robert H. Colley, Atlantic Refining's president, resigned from NPC after stating that he saw no need for a postwar council . . .

WE KNOW

BROWN-BILT

Texas

ALL
Or Any Step
In Design,
Engineering,
Fabrication
Or Erection
of
Process Plants
for the
Oil, Gas
and Chemical
Industries

★

P. O. BOX 2634
HOUSTON 1, TEXAS

. . . Richest state in oil, gas, sulphur, salt . . . heavily productive of many other natural resources.

Texas . . . with fine harbors; good rail, highway and air transportation; rich markets; favorable labor conditions; climate that permits year-round work out of doors.

No wonder Texas is the Capital of the Petro-Chemical Industry. No wonder Chemical makers are coming to Texas for expansion and relocation.

Brown & Root, Inc., knows Texas!

In coming to Texas, you'll benefit from the complete services of Brown & Root, Inc.—old enough to offer 32 years of broad engineering and construction experience in Texas; big enough to carry on $100,000,000 in work at a time; broad enough to handle all or any step in plant location research, process, design, engineering, fabrication, erection . . . AND

WISE enough to give *every* advantage of all their skill and experience to *your* job.

BROWN & ROOT, Inc.

NATIONAL PETROLEUM SITUATION

By **H. J. STRUTH,*** *Petroleum Economist*

PRODUCTION LEVELS OFF. National crude production in September was about 4,786,000 bbl. daily, a decline from August of 77,000 bbl. a day. Production in first nine months of this year was 4,742,000 bbl. daily, which apparently calls for a further cut-back over the balance of this year of 165,000 bbl. With a seasonal slump in demand for motor fuel immediately ahead it is likely that production required to meet demand in last quarter will not exceed 4,625,000 bbl. daily.

STOCK PICTURE CONFUSING. Combined stocks of crude and products in the United States on September 30 amounted to approximately 503,550,000 bbl. On an over-all economic basis they appear to be somewhat above normal working levels. Crude oil stocks, from an over-all standpoint, are at about normal working levels. However, there are numerous instances throughout the nation where certain types of crude oils are short of actual requirements. This is particularly true in the Texas Gulf Coast, East Texas, Oklahoma, and to some extent in the State of California. On the other hand, the stock situation in West Texas is excessive. Refined oil stock figures reflect substantial increases in inventories of fuel oil and motor fuel. Comparative figures show that fuel oil stocks have increased 25,000,000 bbl. over a year ago while motor fuel stocks are up 14,000,000 bbl.

CRUDE PRICES SUBNORMAL. The national average crude price of $1.56 per bbl. is conceded to be subnormal by many in the industry. On the basis of the all-commodity index published by the Bureau of Labor it is relatively only 68. Latest Bureau of Labor Index of all commodity prices is 122 while price of crude relative to 1926 is 83. If crude price was on par with all commodities it would be $2.29 a bbl. instead of $1.56. The tables show that we are now using year 1926 as the basis for computing the index of crude oil prices.

PRICE AND DRILLING. Increases in crude prices granted to the industry have begun to show a marked effect upon drilling activity. During September the industry completed 2577 wells against 2476 in August. Cumulative drilling activity this year increased 6 per cent over last year with more attention particularly being given to development drilling. Wildcat operations, which have been lagging since January 1, are only one per cent above last year. September completions were at the highest level since the prewar period.

*Editor, THE PETROLEUM DATA BOOK.

Comparative Statistics, September, 1946

*All figures are computed on a Bureau of Mines' Basis**

	Sept. 1946(p)	August 1946(p)	Sept. 1945	This year to date	Last year to date	Per cent change
Wells drilling	3,850	3,750	4,100	3,850	4,100	— 6
Total wells drilled	2,577	2,476	2,423	21,327	20,082	+ 6
Development wells	2,179	2,070	2,057	18,221	17,006	+ 7
Oil	1,285	1,276	1,248	11,184	10,397	+ 8
Gas	303	246	239	2,094	1,869	+12
Dry	591	548	570	4,943	4,740	+ 4
Per cent dry	27.1	26.5	27.7	27.1	27.9	— 0.8
Wildcat wells	398	406	366	3,106	3,076	+ 1
Oil	64	65	53	445	411	+ 8
Gas	8	13	12	88	106	—17
Dry	326	328	301	2,573	2,559	+ 1
Per cent dry	81.9	80.7	82.2	82.8	83.2	— 0.4
Crude production	143,580	150,750	132,386	1,294,668	1,304,759	— 1
Daily average	4,786	4,863	4,413	4,742	4,779	
Crude demand‡	151,880	155,050	133,103	1,350,556	1,358,618	— 1
Daily average	5,063	5,002	4,437	4,947	4,977	
Crude stocks	228,550	229,650	224,756	228,550	224,756	+ 2
Days supply	45	46	51	45	51	
Natural gasoline production	9,440	9,870	8,329	84,737	83,382	+ 2
Daily average	315	318	278	310	305	
Motor fuel production	66,200	66,080	60,077	569,938	605,524	— 6
Daily average	2,207	2,196	2,003	2,088	2,218	
Gasoline yield, per cent	40.3	39.5	41.3	38.8	40.8	— 2.0
Motor fuel demand‡	67,940	70,210	68,990	582,772	615,726	— 5
Daily average	2,265	2,265	2,300	2,135	2,255	
Motor fuel stocks	83,730	85,470	69,474	83,730	69,474	+21
Days supply	37	38	30	37	30	
Fuel oil production	58,650	60,620	53,387	544,624	545,569	0
Daily average	1,955	1,955	1,780	1,995	1,998	
Fuel oil demand‡	50,940	54,430	51,867	552,387	591,809	— 7
Daily average	1,698	1,756	1,729	2,023	2,168	
Fuel oil stocks	112,900	100,990	87,881	112,900	87,881	+28
Days supply	66	58	51	66	51	
Refinery still runs	144,930	151,500	128,236	1,295,395	1,307,483	— 1
Daily average	4,831	4,887	4,275	4,745	4,789	
All refined stocks	275,000	¶263,000	231,143	275,000	231,143	+19
Days supply	57	53	48	57	48	

*Unless otherwise stated all figures represent thousands of barrels. (p) Preliminary. ***Does not include input wells.
‡Total demand, including exports. ¶ Revised. **Price 1926 (Index 100

PRELIMINARY ESTIMATES BASED UPON DATA FURNISHED BY AMERICAN PETROLEUM INSTITUTE, U. S. BUREAU OF MINES, STATE AGENCIES AND OTHER OFFICIAL SOURCES.

Economic Position of U. S. Petroleum Industry

Nine Months Ending September 30, 1946

	Normal	Actual	Per cent of normal
Drilling*** (wells completed)	20,475	21,327	104
Production (daily crude output)	4,712	4,742	101
Refining (daily still runs)	4,688	4,745	102
Stocks (crude and refined)	490,025	03.550	103
Price of crude (per bbl.)	$1.88*	$1.56	83

Crude Prices by States for September, 1946

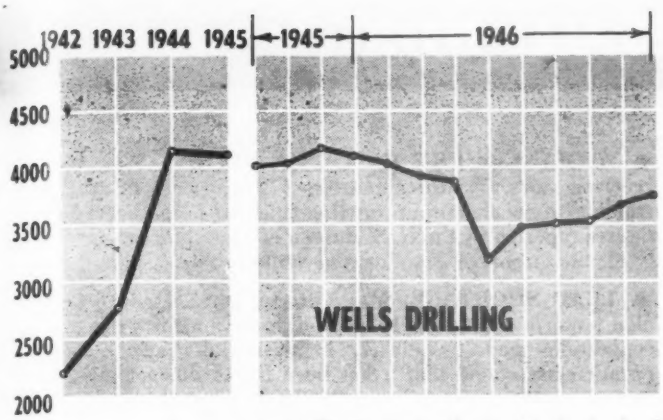
U. S. average	$1.56	Louisiana	$1.57
Texas	1.56	Arkansas	1.38
California	1.41	New Mexico	1.35
Oklahoma	1.58	Mississippi	1.37
Kansas	1.57	Illinois	1.74
		Other states	2.20

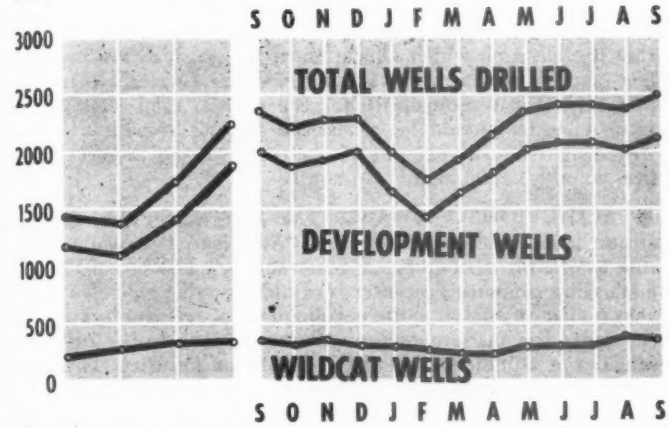
Basic crude prices

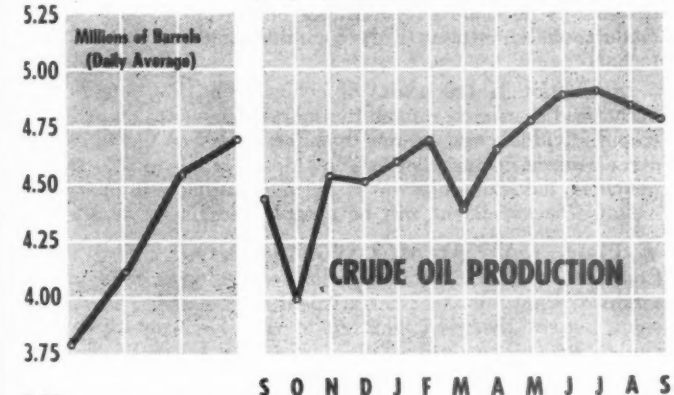
Oklahoma-Kansas (36 gr.)	$1.62
Texas Gulf Coast (36 gr.)	1.75
East Texas	1.60
West Texas (36 gr.)	1.39
Calif. Signal Hill (26 gr.)	1.46
Pennsylvania, Bradford	3.10

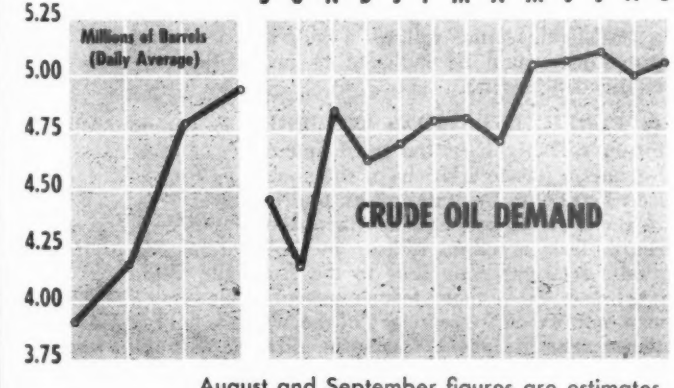
Drilling and Production Statistics by States

	Sept. 1946(p)	August 1946(p)	Sept. 1945	This year to date	Last year to date	Percent change
Total wells drilled	2,577	2,476	2,423	21,327	20,082	+ 6
Texas	652	677	599	5,951	5,313	+12
California	81	86	152	1,219	1,719	—29
Oklahoma	307	283	231	2,051	1,824	+12
Kansas	170	178	166	1,475	1,281	+15
Louisiana	130	127	115	995	837	+19
Arkansas	18	14	14	132	125	+ 6
New Mexico	47	34	28	295	305	— 3
Mississippi	24	13	36	186	274	—32
Illinois	258	203	184	1,742	1,321	+32
Other states	890	861	898	7,281	7,083	+ 3
Wildcats drilled	398	406	366	3,106	3,076	+ 1
Texas	148	151	124	1,189	1,176	+ 1
California	20	28	16	174	178	— 2
Oklahoma	43	51	42	354	354	0
Kansas	28	32	28	223	281	—21
Louisiana	26	29	14	190	130	+46
Arkansas	5	5	4	30	29	+ 3
New Mexico	5	1	10	34	60	—43
Mississippi	6	5	9	56	97	—42
Illinois	65	48	41	365	269	+36
Other states	52	56	78	491	502	— 4
Daily crude production	4,786	4,863	4,413	4,742	4,779	— 1
Texas	2,089	2,138	1,856	2,087	2,137	— 2
California	871	877	866	862	914	— 6
Oklahoma	356	382	384	373	377	— 1
Kansas	280	278	261	264	267	— 1
Louisiana	401	396	353	385	356	+ 8
Arkansas	77	76	76	77	79	— 3
New Mexico	103	105	102	101	104	— 3
Mississippi	73	72	51	62	51	+22
Illinois	207	208	192	208	205	+ 1
Other states	329	331	272	323	289	+12

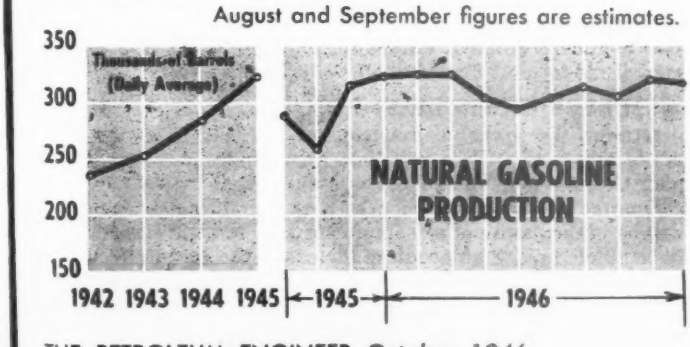


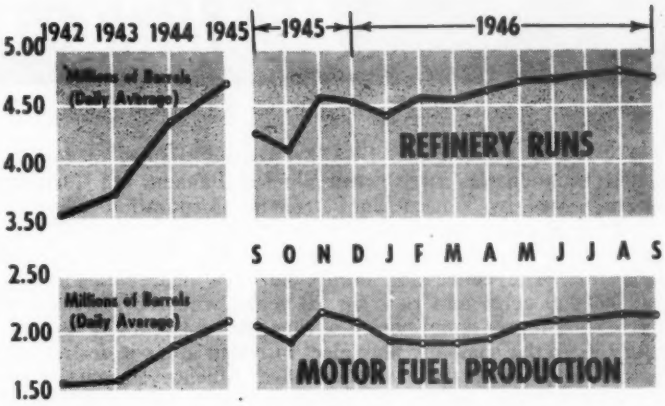


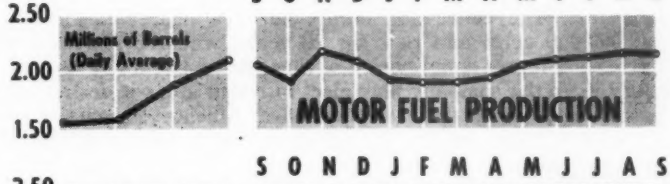


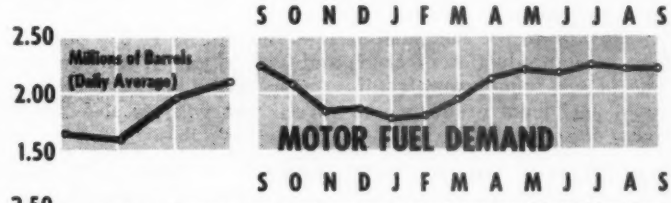


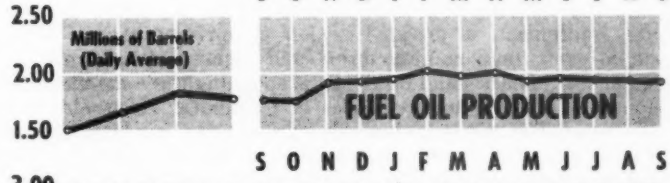
August and September figures are estimates.

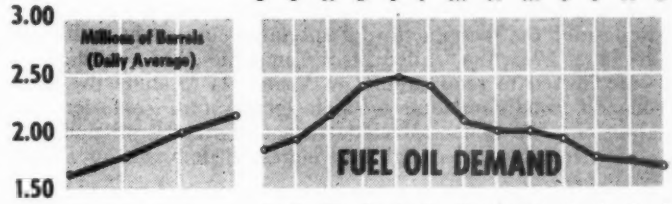


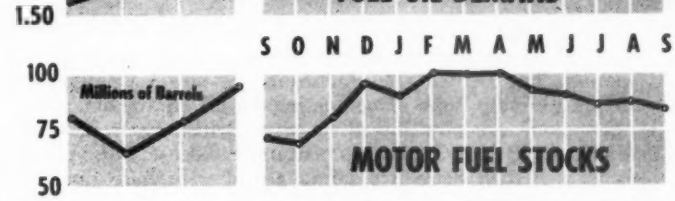


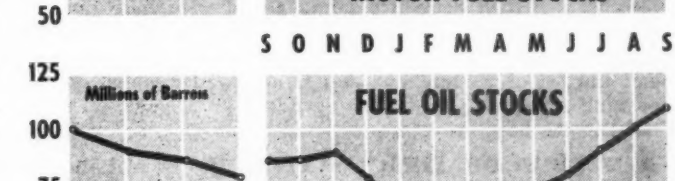


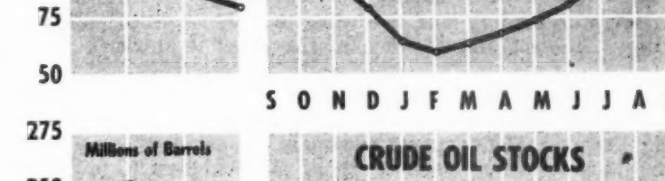




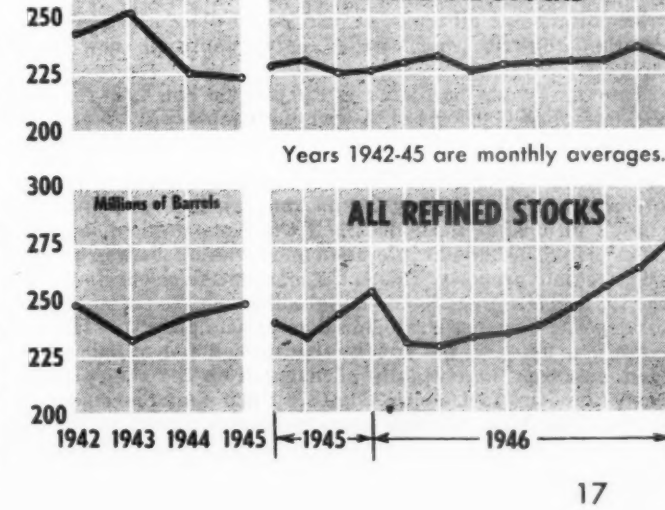








Years 1942-45 are monthly averages.



Highlights IN OILDOM

● **PANAMA GRANTS LEASE.** Another important foreign oil concession was made when Sinclair Panama Oil Corporation, owned by Venezuelan Petroleum Corporation (Sinclair Oil Corporation) and Cities Service Company, received a concession to explore for and produce oil in the Republic of Panama. The concession covers an area aggregating about 18,000,000 acres and runs for 20 years, with the privilege of extension for an equal period of time. After 3 years of exploratory work the company may elect to retain areas it desires, all other lands to be thereafter excluded. Sinclair Panama is required to begin drilling operations within 6 months following the expiration of the period.

Royalty to the Panamanian republic will be 16 2/3 per cent on gross production of crude and natural gas. If the company decides to refine, manufacture, transport and market petroleum and petroleum products, the government is to receive 25 per cent of net profits.

● **BRITISH OIL MISSION SEEKS S. A. BUSINESS.** With a view to gaining huge contracts for British oil field and refining equipment, a private mission comprising experts from engineering tube manufacturers and makers of other equipment for refineries and oil fields, is spending three months on a tour of oil fields and refineries in Colombia, Venezuela, and Trinidad. The mission, although a private one, has been formed by members of the Council of British Manufacturers of Petroleum Equipment, which was inaugurated in 1945 in an effort to develop the manufacture of specialist equipment in Britain. In June, 1945, the United Steel Companies, Ltd., of Sheffield, were invited to send experts to Venezuela to study the many difficult conditions due to high temperature corrosion and abrasion. The Council decided then to form the mission with a view to improved design and increased deliveries of British equipment.

Prior to the war, the supply of oil-drilling and refining equipment in the Caribbean area was practically an American monopoly, but British manufacturers are now forging ahead with the ultimate hope of competing on all equipment. Many U. S. makers are now linked up with British firms, who are manufacturing American equipment under license, but, in other instances, British firms are going ahead with individual designs and policies, independent of American contracts. The mission is led by Mr. G. R. Bolsover, director and chief metallurgist of Samuel Fox and Company. He stated one important Venezuelan oil field is spending £90,000,000 on equipment in the next five years.

● **MEXICAN OIL POLICY STATED.** Mexico will allow no foreign oil explorations, according to a statement of policy by President-elect Miguel Aleman. He added if Mexico's oil industry did not produce more wells, the reserve would be exhausted in 25 years. Aleman said he believed the nation's basic economy was built on successful operation of the oil industry by Pemex, the government monopoly.

Industrialization of the nation, more highways, increased transportation of all types, he said would place a heavy strain on the industry, which drilled only twenty-one new wells in 1944.

Known reserves he placed at 850,000,000 bbl. Consumed at the rate of 36,000,000 bbl. a year the supply will be gone in twenty-five years.

● **SHELL HOLDINGS PRIVATE PROPERTY.** The Supreme Court of Colombia, South America, has ruled that the subsoil of a land where the Shell Oil Company had invested more than $500,000 in exploration and installations was private and not state property. This is the first time since enactment of the 1931 oil law proclaiming the subsoil belongs to the state, that oil deposits have been recognized as private property. The decision was based on the premise that the soil and subsoil of the land involved "were legally alienated from the state's patrimony previous to October 28, 1873" and that the land had been worked since colonial times by its owners.

● **ROMANIAN PRODUCTS TO SOVIET.** Soviet Russia received more than three-quarters (79 per cent) of all the petroleum refinery output of Romania in 1945, according to figures reported by the U. S. Bureau of Mines, including virtually all the output of gasoline and white spirits.

● **LEAD SHORTAGE.** More liberal arrangements for foreign imports of tetraethyl lead and an advance in price are two suggestions made to help the increasing shortage. Ethyl Corporation has stated that it has been impossible for the firm in recent months to obtain even the small quantities of lead allocated to it by Civilian Production Administration. Felix E. Wormer, secretary of Lead Industries Association, emphasizes that the basis on which allocation of foreign lead are made to our country and to other areas never has been made public, and said that responsibility for the current lead shortage in large measure should be placed on the government agencies responsible for the amount of lead that can be imported into this country from month to month.

● **ACHIEVEMENT AWARD.** The American Petroleum Institute has established an annual "American Petroleum Institute award for distinguished achievement." The board created a standing committee on awards of nine members to select each year a man or woman in the petroleum industry who throughout the years has made outstanding contributions to the arts and sciences or administration of the petroleum industry. The committee also may select, from time to time, at its discretion, a similar honoree outside the petroleum industry who has contributed to its achievement. Either one or two awards may be made annually, or none, if the committee finds no one it chooses to honor.

In addition to the medal of achievement, the committee is authorized to investigate and to report to the board on proposals from individuals and groups to endow or defray the expense of other awards, lectures, or scholarships relating to achievement in special fields of endeavor within the petroleum industry. The medal of achievement will be of gold, bearing a scroll.

● **PLAN STATISTICAL UNIT.** The Texas State Railroad Commission will ask the Legislature next year for funds to establish a new oil and gas statistical department. The commissions budget request submitted to the Board of Control includes $63,600 per year for salaries and $15,000 a year for expenses of the statistical branch, starting September 1, 1947.

Chairman Olin Culberson said the commission's request for a statistical section follows a long-felt need and that rider provisions would be included to insure the employment of qualified personnel.

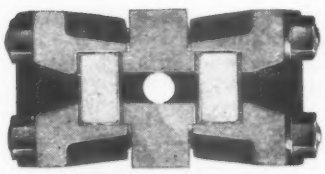
● **PUBLIC RELATIONS CONFERENCE.** A public relations forum will highlight the third annual trade association conference in public relations at the annual meeting of the American Petroleum Institute in Chicago November 1 to 14, William R. Boyd, Jr., president, has announced. Three speakers will be heard. They are Fred Eldean, public relations consultant and public relations councillor to the American Petroleum Institute; Don E. Gilman, former executive and public relations man, now executive secretary of the Western Oil and Gas Association, and Ralph C. Champlin, director of public relations for Ethyl Corporation, former chairman of the sponsoring committee for the national public relations conference. Franklyn Waltman, Sun Oil Company, Philadelphia, will be chairman at the forum.

● **SURVEY OF CRUDE STOCKS.** A nation-wide survey to determine the actual character and availability of refinable crude oil stocks will be undertaken by the Interstate Oil Compact Commission. The survey was authorized by the executive committee of the commission at a recent meeting. The study will be in the nature of a "sample survey," but will be sufficiently complete to give an accurate picture of the amount of usable crude oil in the United States.

FOR EVERY GAGE REQUIREMENT

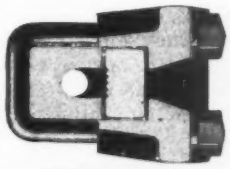
Whatever your liquid level gage requirements, there is a Penberthy Gage that will meet your needs. These gages are suitable for the various pressure and temperature conditions of the oil industry. All Penberthy Gages conform with A.P.I.-A.S.M.E. requirements.

Write for a copy of Catalog 34-A



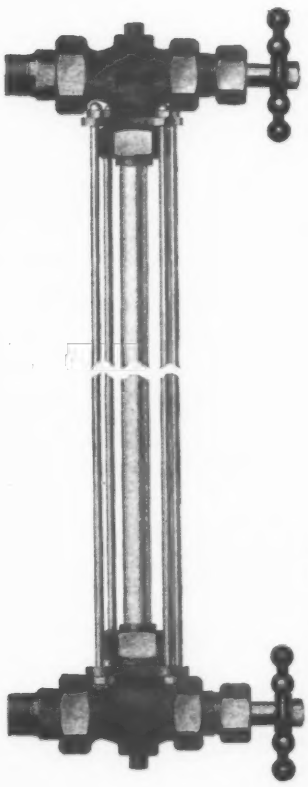
PENBERTHY
Transparent
DROP FORGED STEEL LIQUID LEVEL GAGES

Used to observe color and density of liquids under high pressures, and/or temperatures. Construction is exceptionally rugged . . . similar to Reflex types.



PENBERTHY
Reflex
DROP FORGED STEEL LIQUID LEVEL GAGES

Liquid shows black—empty space shows white. Preferred wherever liquid level must be easily and positively visible . . . and when liquids are under high pressure or at high temperature.



PENBERTHY *Reflex*
WATER GAGE SET

Water shows black—steam shows white. U-Bolt construction is strongest and simplest to service. Glass replaced by simply removing nuts on face of gage . . . unnecessary to work between gage and boiler.

PENBERTHY
DROP FORGED STEEL LIQUID LEVEL GAGES

Made of chromium-molybdenum alloy temperature-resisting steel, extra heavy throughout. Stainless steel trimmed. Tubular glass type gages also available in various other metals suitable for practically all conditions.

PENBERTHY PRODUCTS

PENBERTHY INJECTOR CO.

DETROIT, MICHIGAN • **Canadian Plant: Windsor, Ontario**

MAJOR *Oil Field* ACTIVITIES

● **DENMARK.** Reports have come in that oil has been found on the Danish Island of Mors, northwest of Jutland, according to *The Petroleum Times*. Whether the petroleum is in commercial quantities is not revealed.

● **TEXAS.** A good producer is indicated at W. B. Hinton No. 1 Spurlock, Rice Survey, Henderson County, the well being granted an October allowance of 4470 bbl. The well was tested through perforations at 7741-92 in the Rodessa section after 5000 gal. of acid.

Opening a new field in Ector County, Humble No. 1-B R. B. Cowden has established a daily potential of 1176 bbl. The well, in C NE NE 11-45-2n T&P, flowed 196 bbl. of 44.2 gravity oil in 4 hr. from 8545-85 ft.

Phillips Petroleum Company No. 1 R. B. Cowden, less than 2 miles southeast of Humble's opener of the Andector pool, has discovered a Silurian pool in the North Goldsmith field. It flowed 225 bbl. of oil in 12 hr. through casing perforations above 8310 ft.

A new deep production pool is in prospect for Glasscock County. Shell No. 1 L. C. Clark, 8 miles north of Garden City, flowed 167 bbl. of oil in 9 hr. from 9740-55 ft. The wildcat found no oil in the Ellenburger in drilling to 10,970 ft. and plugged back.

Hinkle Drilling Company No. 1 G. M. Adcock, John Stephenson Survey, has opened a new pool in deep Frio sand for the Port Neches area, Orange County. A test showed 300 bbl. of 37.4 gravity oil from perforations from 8774-8 ft. The total depth is 8954 ft.

Roy Golston et al No. 1 Moody, 32-34-H&TC, is a new discovery in Ward County, rated good for 30.38 bbl. daily. Hole is 2250 ft. deep with pay topped at 2487 ft.

A gas-condensate pool was discovered by Sun Oil Company No. 6 Sullivan, Loma Blanca grant, Brooks County. The wildcat flowed from a 3-sand section topped at 10,155 ft. and perforated at 10,293 ft.

A 4-hr. flow of 196 bbl. through 3/8-in. choke was the test of Humble No. 1-B Cowden, 11-45-2n T&P, Ector County. The Ellenburger discovery is 8600 ft. deep.

● **CALIFORNIA.** D. D. Feldman No. 1 Richardson Estate, wildcat test has opened a new pool in 23-3n-21w, of the South Mountain area. It produces from 4676 ft. at the rate of 70 bbl. of 25 deg. API oil, cutting 30 per cent.

Superior Oil Company and British-American Oil Producing Company have completed a successful wildcat in the Del Valle area. The No. A-3 Black, 13-4n-18w, is pumping 71 bbl. of 18 gravity oil from 4692 ft.

● **COLORADO.** In Archuleta County one of the highest wells in the world may bring in a new pool. This is Byrd-Frost, Inc., No. 1 Taylor, 14-33n-2e, a wildcat drilled from an elevation of 8600 ft. It logged Dakota sand showing oil at 2120-31 ft.

Indications of a new pool in northwestern Colorado were found by Continental Oil Company No. 1 Smith, 30-5n-93w, Moffat County. From a depth of 6089-111 ft. 210 ft. of oil was recovered on a 20-minute drillstem test.

● **ILLINOIS.** White County appears to have a new pool, opened by C. E. Brehm Everhart No. 1 Callicotte, SE SE NW 10-6s-10e, in the Aux Vases formation. From 2946-66 ft. 10 bbl. of oil an hour were swabbed.

● **OKLAHOMA.** A new pool for Cotton County was found by Erle P. Halliburton, Inc., No. 1 Tilley, SW SW NE 23-1s-10w. The well found a deeper producing sand than that in the old Walters area. From a depth of 2328-45 ft. a drillstem test recovered 420 ft. of clean oil.

Another Cotton County opener is S. D. Johnson and Alco Valve No. 1 Simon, NE SE NW 9-3s-11w, which had producing sand at 1580-1615 ft.

A new field seems certain for Payne County where Fleet Drilling Company and C. W. Roodhouse No. 1 Ball-A blew an estimated 250,000 cu. ft. of gas and recovered 225 bbl. of oil in one hour drill stem test. The wildcat, in NE NE SW 10-18n-3e, northwest of the Mehan field, has the Bartlesville sand at 3927-50 ft.

The Hugoton gas field has been extended about 10 miles to the west or a new producing area has been discovered by Cities Service Oil Company No. 1 Buzzard, 28-4n-12ecm, Texas County. The well tested about 1,200,000 cu. ft. of gas a day through perforations at 2604-24 ft. Production is from the lower Krider zone.

Olson Drilling Company et al have opened a new gas area near Chandler in Lincoln County with No. 1 Masten, NW SE SW 35-14-4, at 3022 ft. total depth. Production of 7,000,000 cu. ft. showed on a drillstem test from the Cleveland sand.

Indications of a new pool northwest of Perry in Noble County were found by T. T. Eason and Company No. 1 Carter-Boyes, SE NE SE 19-22-1w. Tubing was perforated below 4560 ft. and acidized with 1000 gal. Well flowed an estimated 150 bbl. in 24 hr.

The Paden area of southeastern Okfuskee County may be getting a new Hunton lime reserve from the Mid-Continent Petroleum Corporation No. 1 Baker, SE NE NW 31-17-7e. Drilled to 4361 ft. the wildcat had a showing of oil and gas on a 120-minute drillstem test at 4308-61 ft.

A dual completion of Skelly Oil Company No. 2 Divis, SE SW NW 30-10n-3w, west edge of West Moore field in Cleveland County, will be made in the Viola lime and Wilcox sand. Some 200,000 cu. ft. of gas from the Viola will be injected into the Wilcox, which is good for about 30 bbl. daily. The Viola was topped at 8402 ft. Total depth is 8759 ft.

A new zone-opener is the Carter Oil Company No. 1 Eskridge, NE NW SW 19-4n-2w, in the Southwest Maysville pool, Garvin County. The well will be completed as a lower Bromide producer at 7390-400 ft. Gauge showed up to 50 bbl. of oil per hour. Production in the condensate zone above was squeezed out.

● **LOUISIANA.** Lake Ponchartrain, St. Tammany Parish, has received its first production after months of activity in the area. The discovery is Atlantic Refining Company No. 1-A State in the Big Point area. It flowed 6,200,000 cu. ft. of gas through perforations from 7180-88 ft.

Shell Oil Company No. 39 Heyd, 13-9s-7w, has opened a new producing zone in the Iowa pool of Calcasieu Parish on the coast. It has been completed for 259 bbl. a day of 34 gravity oil from 5080-88 ft.

California Oil Company No. 4 E. P. Brady in the Alliance area, 19-16s-24e, may have discovered a new deep pool. Drilled to a total depth of 14,187 ft., a successful drillstem test is said to have been made in the 13,476-96 ft. zone.

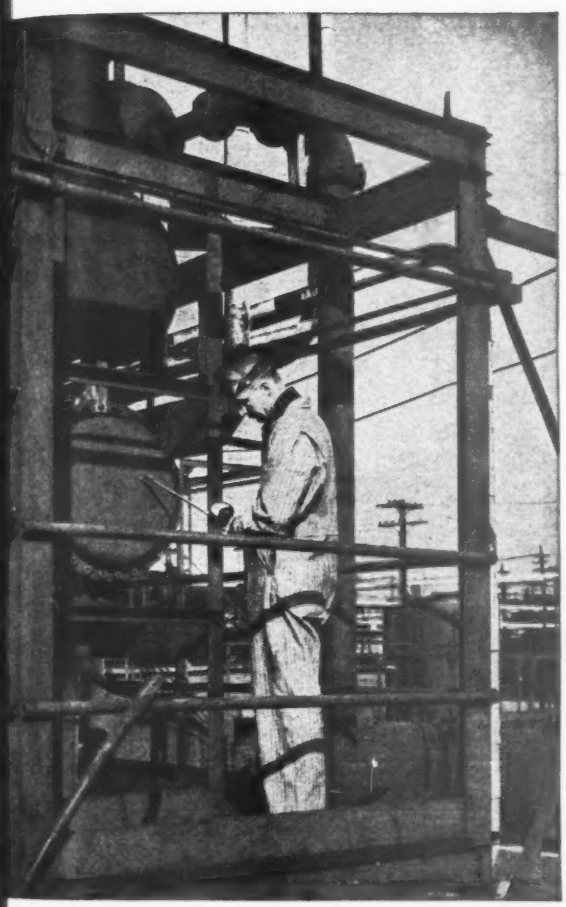
● **INDIANA.** The first commercial well on property belonging to the State of Indiana has been completed by C. A. Lynch et al. The test is completed in the Waltersburg sand from 2098-137 ft. with total depth 2169 ft. Initial production is reported to be 425 bbl. of oil pumped in 24 hr. The well is situated in the Mink Island area of Posey County in the Wabash River bed.

● **KANSAS.** Bridgeport Oil Company No. 1 Pride "C," NE NE NE 24-29-13w, appears to have opened a new pool in Pratt County. The discovery well flowed 164 bbl of oil a day when tested.

● **NEW MEXICO.** Another Lea County discovery is Barnsdall Oil Company No. 1 Hardy, 29-21s-37e, more than a mile northwest of the Drinkard field. The well tested 135 bbl. a day from 6514-652 ft.

Byrd-Frost, Inc., No. 1 Hargrove-Federal, 4-27n-10w, at Kutz-Canyon in San Juan County, tested Mesa Verde sand at 4406-52 ft. for one hour and got 50 ft. of oil and gas cut mud, indicating a possible pool. The wildcat is now drilling ahead to the Dakota sand, expected about 5400 ft.

DOWELL



Increase heat exchange efficiency!

With chemical cleaning service

To restore designed efficiency—to meet production schedules, and to maintain peak loads over long periods of time, leading plant engineers are relying more and more upon the Dowell *chemical* method of removing accumulated scale and sludge from heat-exchange equipment.

Dowell offers a complete service—including preliminary inspection, scale analysis, and the preparation of proper chemicals to accomplish *rapid* cleaning. Dowell specialists bring with them adequate equipment to control every stage of the treatment. They do the job and they do it right!

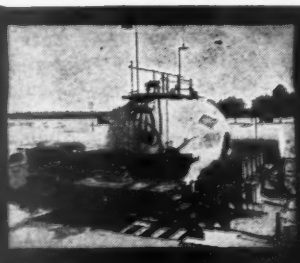
FREE SHOWING! Now available—a new 18-minute sound slide film illustrating the possibilities of Dowell Chemical Scale Removal Service. A Dowell representative will gladly arrange a special showing at your plant, office or organization meeting. Call or write Dowell today.

DOWELL INCORPORATED • TULSA 3, OKLAHOMA

Subsidiary of The Dow Chemical Company

New York • Philadelphia • Baltimore • Buffalo • Cincinnati • Cleveland • Chicago
Detroit • St. Louis • Houston • Kansas City • Wichita • Pittsburgh
Mt. Pleasant, Michigan • Salem, Illinois
Long Beach, Casper: Dowell Affiliate—International Cementers, Inc.

SPECIALISTS IN CHEMICAL CLEANING SERVICE



DOWELL

MAJOR *Refining* ACTIVITIES

● **CONSTRUCTION BEGINS ON CHEMICAL UNIT.** Lion Oil Company has begun construction at its Chemical Division plant near El Dorado, Arkansas, of three new 45-ton-per-day capacity ammonia oxidation units for the production of nitric acid, T. H. Barton, president, has announced. This new construction will increase present nitric acid capacity by approximately 50 per cent. Ground for foundations has already been broken at the plant and erection will proceed at once.

The new units include complete facilities for nitric acid production and certain additional facilities, which will be installed, will permit the company to make nitrogen solutions, adding a new product to the company's Chemical Division sales.

At capacity operation the new facilities will be capable of diverting some 4000 tons per month of present anhydrous ammonia production into more than 9000 tons of solution with a nitrogen content of approximately 40 per cent.

● **TO MAKE ANTI-FREEZE.** Ethlyene glycol and ethylene oxide are among the initial products that will be manufactured at Port Neches, Texas, by Jefferson Chemical Company, Inc., it was announced by P. M. Dinkins, Jefferson's president. Jefferson Chemical was organized in November, 1944, by The Texas Company and American Cyanamid Company to produce chemicals from petroleum and petroleum gases.

Ethlyene glycol is best known as an antifreeze for automobile radiators. This use alone consumes millions of gallons each year. In addition, ethylene glycol finds important applications as a brake fluid, in the processing of textiles and tobacco, and in the manufacture of low-freezing dynamite, cellophane, synthetic resins, cosmetics and other products.

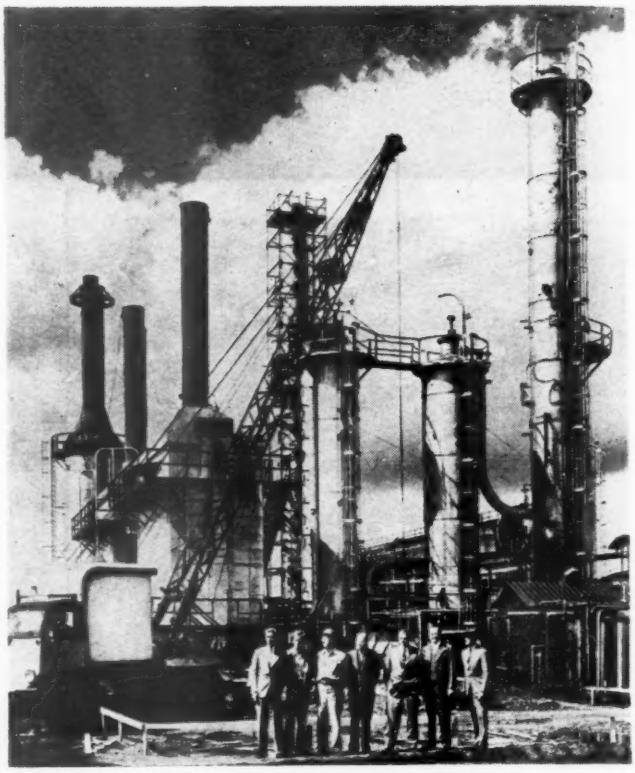
Ethylene oxide is an intermediate chemical which can be employed in the production of a wide variety of other compounds. One of its most interesting uses is in the manufacture of acrylonitrile, a material that goes into synthetic rubber of the Buna-N type and is important also in the production of acrylate resins and plastics.

Construction of Jefferson's first plant is well under way at Port Neches. Actual production is expected to begin during the summer of 1947. Construction of the plant itself is being handled by The Lummus Company and by E. B. Badger and Sons Company. O. W. Collins of Port Arthur, Texas, is the contractor for the office and laboratory building, the locker building, and the gate house, which were designed by the Beaumont firm of Stone and Pitts. Design of general plant facilities is in the hands of Jefferson's engineering department.

● **MARCUS HOOK FIRE.** The explosion and fire at Sun Oil Company's Marcus Hook refinery October 3 had its origin in the failure of a packing gland in a pump of the alkylation unit of Plant 15, which was built during the war to produce superaviation gasoline for the armed forces, according to J. Howard Pew, president, Sun Oil Company. The result was a leakage of gas, which ignited. This started a fire of intense heat, subsequently weakening a large tower that fell. Highly volatile contents of the tower spread and flashed into flames. This single, instantaneous flash caused all the casualties.

A minute investigation of every phase of the operation of this unit is being made, Pew stated. He continued, "No evidence has been found indicating any carelessness. Thorough inspection of all installations at Marcus Hook is constantly carried out in accordance with the most advanced engineering and safety practices. Every precaution is taken at all times for the safety of our workers. Marcus Hook Refinery's safety record over the years has ranked high in the industry.

"Least of the results of the fire is damage to equipment. This was confined to the alkylation unit, one of 30 plants at Marcus Hook Refinery. Repairs can be made within reasonable time. Preliminary estimates indicate a loss of approximately $300,000. Operations of the refinery, as a whole, have been affected only in a minor degree."



Guide construction of new unit.

● **WORK BEGINS ON CRACKING UNIT.** Ground has been broken for the construction of the first post-war small-scale catalytic cracking plant at Leonard Refineries, Inc., Alma, Michigan. The unit, a Houdry-licensed thermofor catalytic cracker, is being built by Catalytic Construction Company under sub-contract with Houdry Process Corporation and is expected to be completed before the end of the year.

Executives of Leonard Refineries, Houdry Procss Corporation, and Catalytic Construction took part in the ground-breaking ceremonies, which marked the commencement of expansion of the modern Leonard Refineries to include catalytic cracking. The Leonard unit will process 3000 bbl. per day of charging stock and is designed with a per barrel investment and operating cost comparable to that of larger catalytic cracking plants.

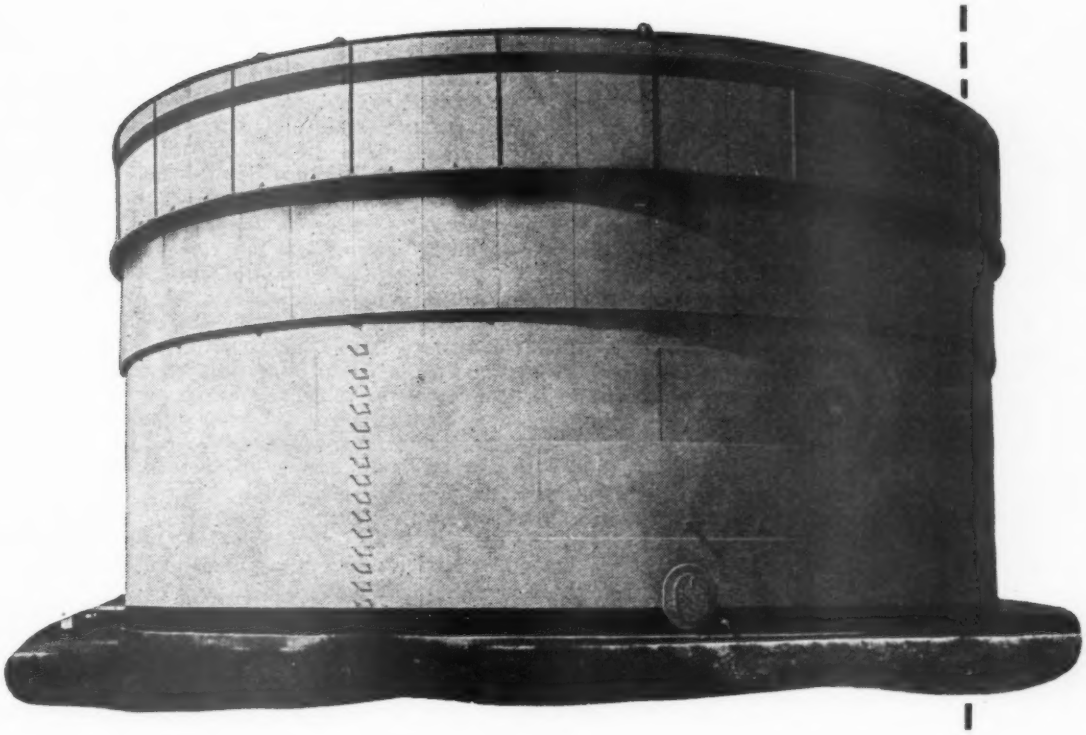
Shown in the photograph above are (left to right) Harmen J. Mennik, chief engineer, Catalytic Construction Company, and manager, mechanical engineering division, Houdry Process Corporation; Charles Linck, construction field superintendent, John Sheller, field superintendent of Catalytic Construction Company; John Pfarr, chief engineer, Leonard Refineries, Inc., Alan T. Knight, vice-president, Catalytic Construction Company; Reid Brazell, president, Leonard Refineries, Inc., and T. Ellwood Webster, president, Catalytic Construction Company, and vice-president, Houdry Process Corporation.

● **PROCESS LABORATORY.** Standard of California announced award of a bid for construction of a process laboratory building at the Richmond plant of California Research Corporation, Standard subsidiary. The contract was won by Swinerton & Walberg Company with a low bid of $732,360. Work will begin immediately.

The new structure will centralize research facilities now housed in a number of smaller buildings and provide space for additional research work not now possible. The construction will be part of the $10,000,000 replacement, improvement and new construction program announced for Richmond Refinery and California Research Corporation early this year.

PROVED in the field

Eight years of satisfactory service in the field—at refineries and terminals everywhere—have earned the Expansion Roof *universal acceptance among oil men.* For the conservation of petroleum vapors through elimination of breathing and filling losses, for simplicity and ruggedness of construction, for low maintenance costs, the Expansion Roof has been *proved* the best. Through manifolding, protection can be afforded as many as eight standard cone roof tanks. You will be money, and gallons, ahead when you specify *proved* conservation equipment, the Expansion Roof.



Fabricated Plate Division

GRAVER

For other types of conservation equipment . . . Floating Roof Tanks, Bullets or Spheres . . . call on Graver, leader in the manufacture of fabricated plate products.

GRAVER TANK & MFG. CO., INC.
4811-61 Tod Avenue, East Chicago, Indiana

New York **Philadelphia** **Pittsburgh** **Chicago**
Catasauqua, Pa. **Port Arthur, Tex.** **Sand Springs, Okla.**

MAJOR *Pipe Line* ACTIVITIES

● **VENEZUELA GETS PIPE LINE.** Plans for the construction of the largest diameter oil pipe line in the world, to be built by the Creole Petroleum Corporation between La Salina, Maracaibo, and Paraguana Peninsula, in Venezuela, have been revealed with the placing of an order with The Cooper-Bessemer Corporation, of Mount Vernon, Ohio, and Grove City, Pennsylvania, for 16 of its Type LS-8-cylinder gas-diesel and diesel engines. The pipe line is to be used primarily for transporting crude oil to the company's refinery at Amuay Bay, a distance of approximately 150 miles. From the refinery, oil will be pumped directly to oil tanker loading docks in the same vicinity.

Twelve gas-diesel engines are to be used to furnish power for two pumping stations at Ule and Dabajura. These will drive pumps and each will be rated 1000 hp. at 300 r.p.m.

The other four units, supercharged LS diesels, will be in the Amuay Bay power station to drive generators for loading pumps, discharging oil into ocean-going tankers at the docks and for general electrical power. These will operate at a speed of 327 r.p.m., producing 1575 hp. each.

● **CALIFORNIA SECTION OF WESTERN LINE.** Contract for installation of the California portion of the Texas-California natural gas pipe line was awarded by Southern California Gas Company and Southern Counties Gas Companies to H. C. Price Company. This construction involves an expenditure of approximately $3,750,000.

The contract calls for the installation of 214-miles of 30-in. high pressure natural gas transmission line between Blythe and Santa Fe Springs, the largest diameter high pressure pipe line of its kind in the history of the natural gas industry. H. C. Price Company, a California corporation with offices in Los Angeles, San Francisco, and Bartlesville, Oklahoma, participated in the building of both the Big Inch and Little Big Inch oil lines. H. C. Price, president, predicted that this line, in view of its size, will undoubtedly be known as the "Biggest Inch."

Price states actual construction will be under way by the first of the year. It is estimated that approximately 1000 men will be engaged in the field construction most of whom will be recruited from local sources. The 60,000 tons of pipe required for this portion of the line is now being fabricated by Consolidated Steel Corporation, Ltd.

The California line is part of a 1200-mile pipe line that will transport gas from West Texas and New Mexico to Southern California and it is designed to augment natural gas supplies from California sources. The El Paso Natural Gas Company, which will build and operate the line from Texas to the California border, has work already under way.

H. C. Price, president of H. C. Price Company, and F. S. Wade, president of Southern California and Southern Counties Gas Companies, sign contract for California part of "Biggest Inch."

● **HUMBLE OPENS PRODUCTS LINE.** Humble Pipe Line Company's new 8-in. finished products line was formally opened October 15. It connects Humble Oil and Refining Company's Baytown refinery, one of the world's largest and most modern, with the heavy consuming areas of North Texas. Beginning 276 pipe line miles away on the Texas coast, the new underground artery ends at Irving, between Fort Worth and Dallas. Storage and terminal facilities have been provided for 150,000 bbl. of products, and delivery has commenced from the North Texas terminal by rail and transport trucks to sales outlets.

Built of all new steel pipe, the products line has a capacity of 15,000 bbl. daily. Total cost was about $4,000,000. It was coated and wrapped by the latest double-wrap machine, which automatically spiraled on a layer of thin Fiberglas under the conventional wrap of asbestos felt. To guard against corrosion, electrical connections for the cathodic protection process were installed at half-mile intervals.

Immediately after each segment of line was welded, it was put under air pressure of 100 lb. per sq. in. and welds were tested for leaks. Later, as the line was completed, sections between block valves were filled with gasoline and subjected to a hydrostatic pressure test of 1500 lb. per sq. in.

Pump stations are at Baytown and Hearne, with delivery terminals at Houston, Hearne, Waco, and the Fort Worth-Dallas plant. Pumps are multiphase electrically driven centrifugal type.

● **MAJOR PIPE LINE PROGRAM.** The Texas Pipe Line Co., a subsidiary of The Texas Company, is planning construction of two south Texas pipe line projects next year at an estimated cost of $5,000,000 and is surveying for a possible third project in northern Texas which may involve a cost of $20,000,000, according to B. E. Hull, president of the pipe line company.

Projects in south Texas will consist of improvements in the company's pipe line system, mainly in laying larger lines in place of several existing smaller ones. A 16-in. line will be laid for 80 miles from the West Columbia field to Houston, replacing two 8-in. lines. It will have a capacity of 90,000 bbl. daily. Also a 22-in. line will be laid 100 miles from Houston to Port Arthur, replacing five existing various size lines. The line will serve important refining facilities on the Gulf.

These two lines will make available considerable smaller size pipe, which is expected to be needed soon in several additional projects, where the necessary pipe otherwise might prove to be hard to obtain.

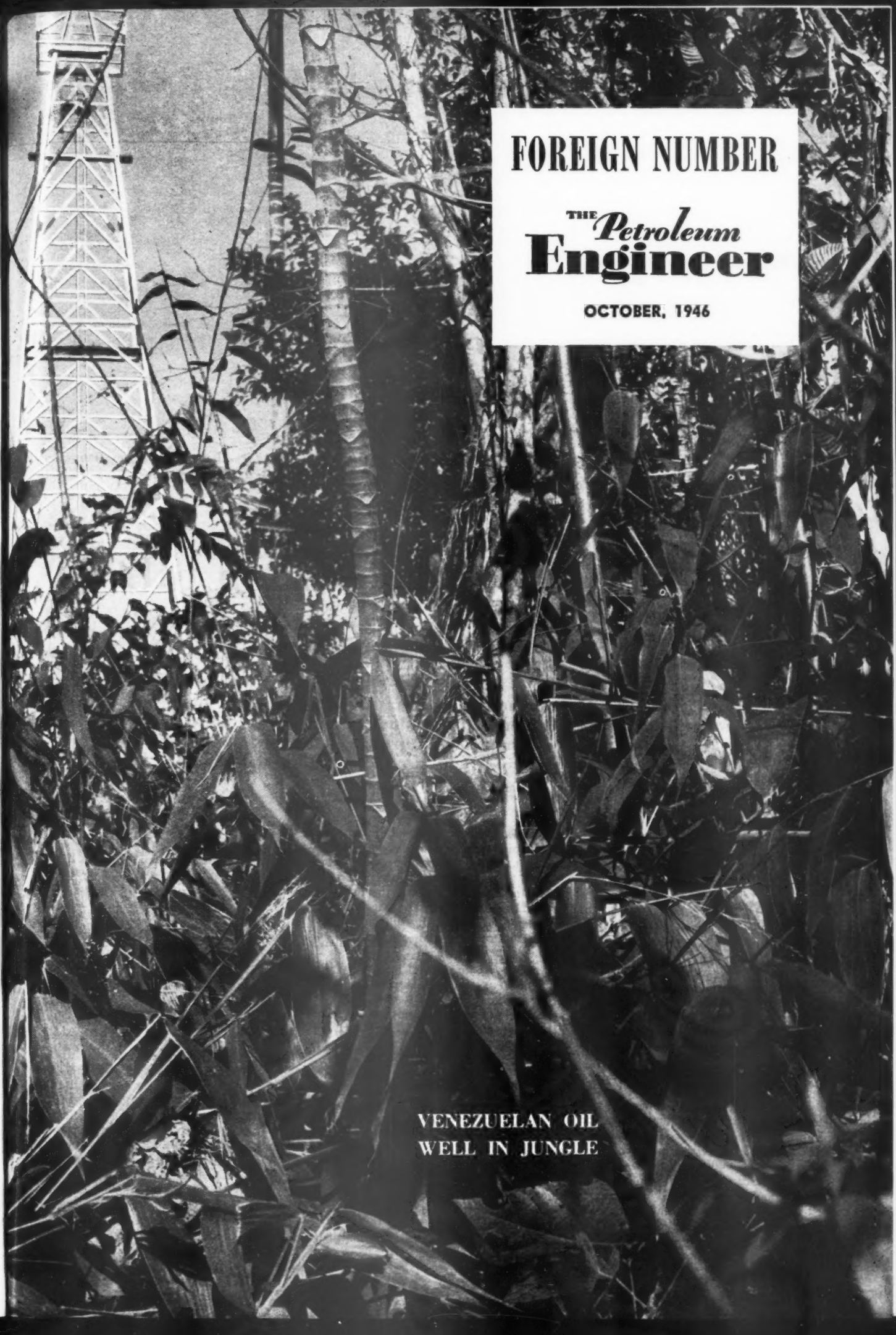
The company is also contemplating a plan to construct a long, 20-in. line from Midland, west Texas, northeastward to west central Texas, thense to Cushing, Oklahoma, as an additional outlet for west Texas and New Mexico crude into Oklahoma. The line from west Texas would be 440 miles long, with rated capacity of 150,000 bbl. daily. Plans for the line have not been completed. Several firms are said to be dealing with the company for part of the line's capacity.

Both new south Texas lines are expected to be in operation by January 1, 1948.

● **SHELL INSTALLS TELETYPES.** Shell Pipe Line Corporation has replaced its private Morse-code telegraph service with teletypewriters, it was announced by F. W. Littell, superintendent of the company's Communications and Transportation Department.

The new communications system includes automatic teletype machines at Houston, Deer Park, Colorado City and McCamey, Texas; Tulsa and Cushing, Oklahoma, and St. Louis, Missouri, in addition to private and leased telephone lines along the company's 4000 miles of pipe line in seven states. Connections through the relaying office in St. Louis permit teletype service to major cities on both East and West coasts.

● **NEW MONTANA PIPE LINE.** Federal Power Commission has authorized the Montana-Dakota Utilities Company, Minneapolis, Minnesota, to construct and operate 28½ miles of 10¾ in. gas transmission pipe line in Valley County, Montana, at an estimated cost of $280,000.

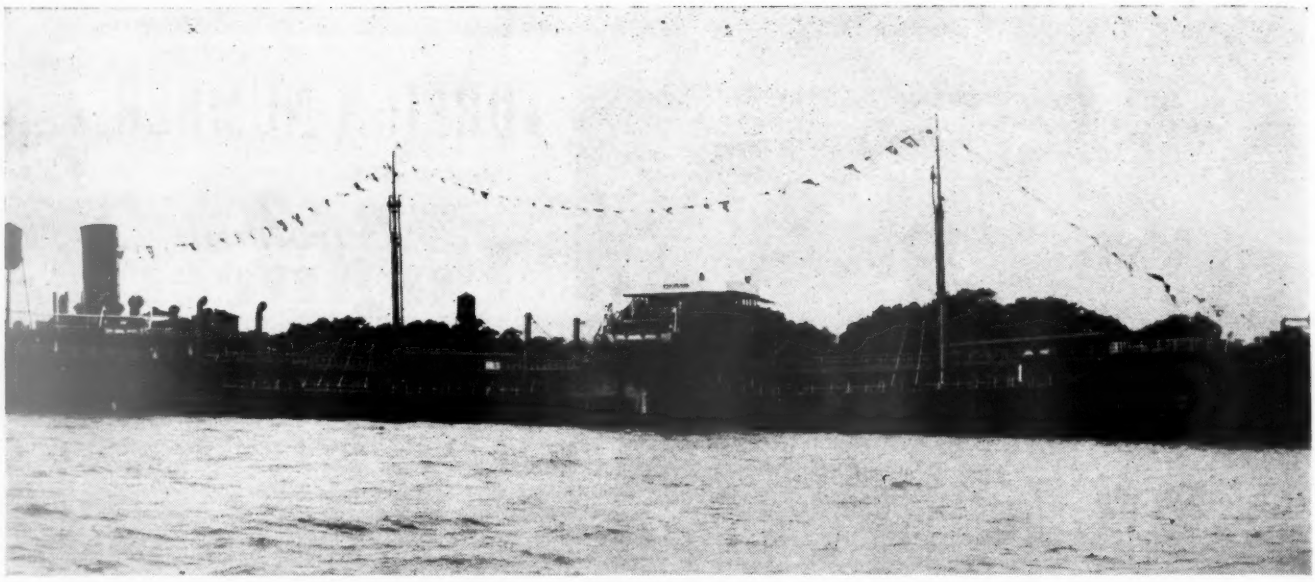


FOREIGN NUMBER

THE *Petroleum* **Engineer**

OCTOBER, 1946

VENEZUELAN OIL WELL IN JUNGLE



The 16,552-ton Mobilight of Socany-Vacuum Oil Company, Inc., as she arrived from Beaumont, Texas, at the new Charleston, South Carolina, marine terminal with 5,461,000 gallons of oil products.

Are we importing too much oil?

By **H. J. STRUTH,**[1] *Petroleum Economist*

Nation may become net importer of petroleum but only future will tell whether U. S. producers and refiners will be in position to benefit monetarily through policy of importing heavy oils and exporting light products and special crudes.

CONSIDERABLE attention has been focussed on imports of foreign oil into the United States and whether these are excessive. Comparative figures reveal the fact that imports this year may approach the all-time peak established in 1922, when the daily average was 372,000 bbl. Present indications point to daily average imports of foreign oils this year of at least 366,000 bbl. The figures are impressive, but they merit careful analysis of the relationship to the American petroleum supply and demand picture for 1946 to determine whether they present a disturbing outlook.

EXCLUSIVE

Demand for all oils in the United States this year, including exports, is expected to aggregate 1,940,000,000 bbl. Total imports of crude oil and refined products this year will be in the order of about 134,000,000 bbl. Imports will, therefore, constitute 6.9 per cent of the total U. S. demand in 1946. By comparison, the average annual imports of all oils in five prewar years, 1935-39, constituted 4.4 per cent of the U. S. demand for all oils. The increase in ratio of 2.5 per cent this year over the prewar period is due to greater imports of specialty type foreign crude oils and the importation of residual fuel oils that are definitely not available in sufficient quantities from crudes produced and refined in the United States.

Analysis of foreign oil imports shows that this year's receipts will be composed of 32 per cent residual fuel oils, 65 per cent foreign crude oils and 3 per cent of all other refined products. In fact, 90 per cent of the influx of refined products from foreign countries this year is classed as heavy, residual fuel oil. In comparison with five prewar years, 1935-39, imports of refined products this year will probably show an increase of about 59,000 bbl. daily; however, more than 53,000 bbl. a day of this increase will comprise heavy, residual fuel oils.

Projected imports of crude and products for 1946, in comparison with prior periods, are presented in the following condensed summary:

1946 Foreign Oil Imports*

	Total, bbl.	Daily average, bbl.	Per cent
Crude oil	86,500,000	237,000	64.7
Residual fuel oil	42,500,000	116,000	31.8
Other refined oils	4,700,000	13,000	3.5
Total, 1946	133,700,000	366,000	100.0
Total, 1945	113,373,000	311,000	
Annual average, 1935-39	56,052,000	153,000	
Peak, 1922	135,974,000	372,000	

*Projected for full year, based upon first 7 months.

Back in 1922, when the all-time peak of foreign oil imports was established, receipts of crude oil from Mexico actually displaced domestic crude production to the tune of 356,000 bbl. daily. In that year, crude oil imports comprised 96 per cent and imports of refined products amounted to only 4 per cent of the total volume. During that period, imports constituted nearly one-fourth of the U. S. demand for all petroleum. By comparison, this year's imports comprise about 7 per cent of the total U. S. demand.

Table 1 shows the history of petroleum

[1]Editor of THE PETROLEUM DATA BOOK.

imports in relationship to U. S. demand since 1918. The 1946 figures are projected for the full year on the basis of actual data for the first seven months of this year. Attention is called particularly to the comparison between 1946 and the average of five prewar years. The increase in percentage imports to demand is explained by the necessarily larger imports of residual fuel oils and the increased receipts of special types of foreign crude oils required for the manufacture of numerous specialty products. Importers claim that a substantial share of the crude oils that are being imported into the United States provide a variety of specialty products that cannot be made in sufficient quantities from crude oils produced here. Likewise, increased imports of residual fuel oils, produced largely by refineries in the Netherlands West Indies, from South American crudes, make up for a deficiency of that product made from light crudes produced in the United States, making a difference in ratio of 2.5 per cent.

Disruption of civilian and industrial economic conditions in foreign countries is reflected by the relationship of American exports of petroleum and its products to the total demand for U. S. crude and products in 1946, as compared with the five prewar years. This year it is apparent that exports to foreign countries will be equivalent to only 8 per cent of the total U. S. demand, whereas in the five prewar years ending with 1939, the average was 12.7 per cent of our total demand.

One disturbing factor in the American petroleum export outlook is the probability that many of our prewar foreign markets will meet with strenuous competition from major foreign sources of supply. With vast unproduced reserves of crude oil in the Middle East (Iran, Iraq, and Saudi Arabia) and the liklihood that new and greater sources of oil supply are projected in Venezuela, Colombia, Brazil, and Argentina, many of our former outlets for certain types of petroleum products are likely to dwindle to a considerable degree. Refining capacity already available and projected for the future in the Persian Gulf area and in the Caribbean area, as well as on the South American mainland, may prevent a flood of crude oil from coming into the United States, but must in turn result in the loss of foreign markets for products formerly provided by the United States.

As world supply and demand projections imply the possibility of probable shifts in future petroleum supply centers, the 1946 foreign trade picture may be looked upon somewhat as a forerunner of the future outlook. Table 2 presents data on imports and exports, showing the percentage of imports to exports since 1918. This year, due to disrupted foreign markets for American petroleum and its products, the volume of exports is below normal expectancy. As a result, petroleum imports represent about 85.7 per cent of our exports. This means that our balance of foreign trade represents a slim margin of less than 15 per cent. In the five prewar years, 1935-39, our foreign trade balance was more than 65 per cent in our favor.

Our crude oil exports are expected to be at about the same level this year as they were in 1945, in the order of between 32,000,000 and 33,000,000 bbl. In the five prewar years our crude oil exports were nearly twice as much, or 63,661,000 bbl. annually. Exports of refined products this year will be about 123,500,000 bbl., which represents a decline from 1945 of about 19 per cent. As a result of continued heavy offshore military requirements and UNRRA shipments, however, this year's export volume will show a net increase over recent pre-war years of about 20 per cent. It should be noted that the year 1944 was the peak year for exports of refined products, reflecting the heavy overseas shipments of war products.

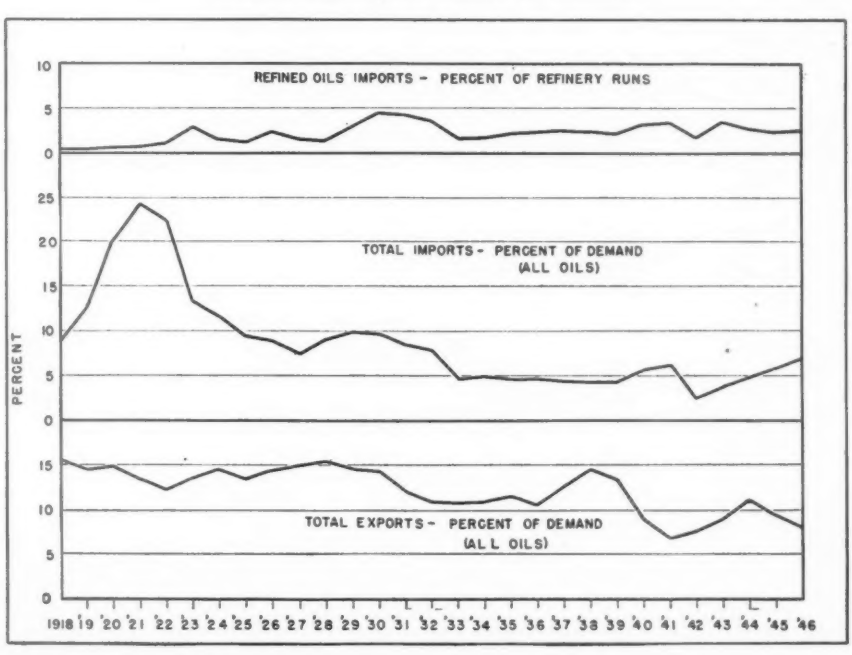
Imports of crude oil have shown a tremendous increase this year as compared with the prewar rate. Projections indicate that crude oil imports for 1946 will aggregate about 86,500,000 bbl. as compared with an annual average in the five prewar years 1935-39 of 30,000,000 bbl. This represents an increase over prewar of 185 per cent. In the five prewar years

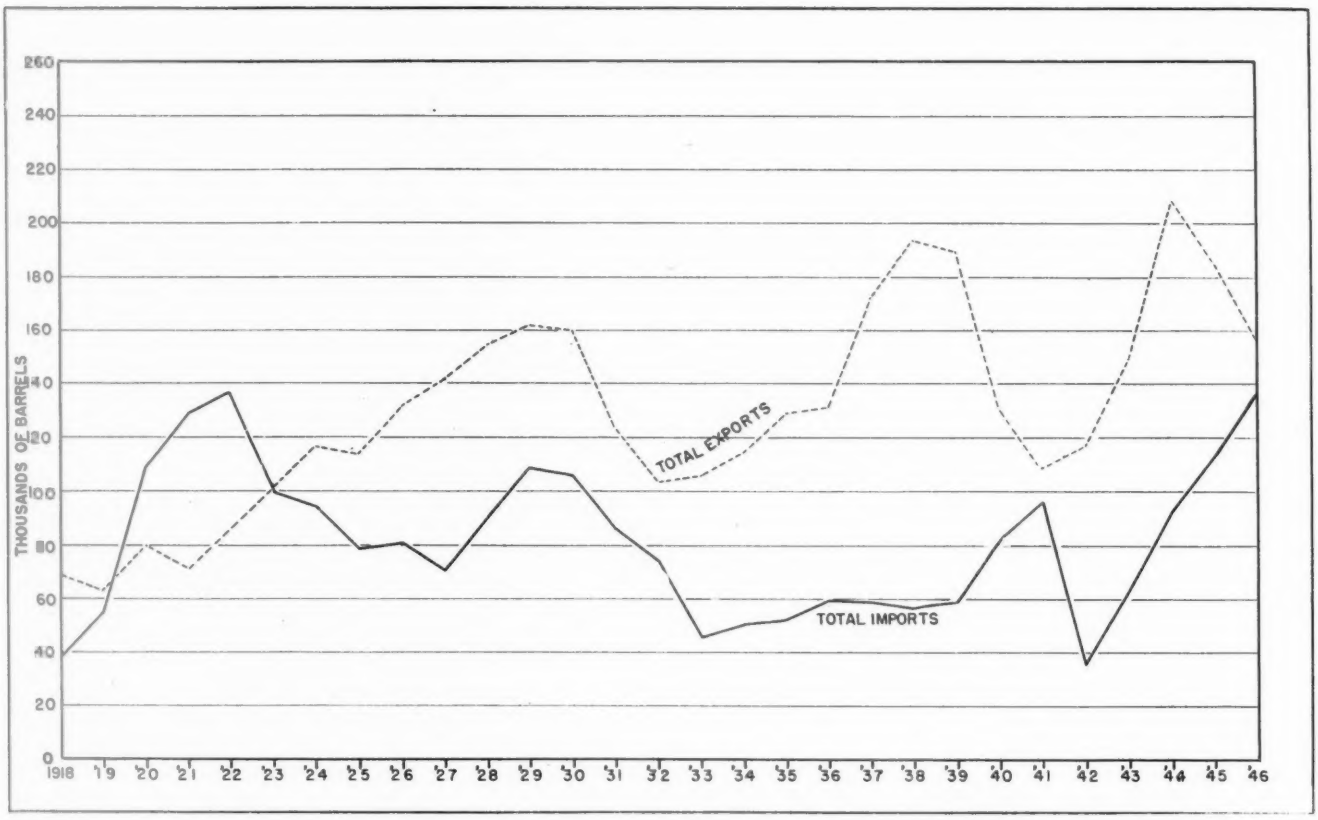
TABLE 1
Imports and exports related to demand

Year	Total demand, all oils	Total imports	Total exports	Total imports, per cent of demand	Total exports, per cent of demand
	(1)	(2)	(3)	(4)	(5)
1918	432,600†	38,963	68,012	9.0	15.7
1919	438,434	54,198	63,848	12.4	14.6
1920	535,382	108,822	79,576	20.3	14.9
1921	529,402	128,792	71,652	24.3	13.5
1922	605,540	135,974	74,344	22.5	12.3
1923	754,361	99,653	101,981	13.2	13.5
1924	805,070	94,581	117,144	11.7	14.6
1925	840,818	78,200	113,834	9.3	13.5
1926	912,893	81,320	131,950	8.9	14.5
1927	944,762	71,736	141,649	7.6	15.0
1928	1,014,716	91,557	154,449	9.0	15.2
1929	1,103,203	108,710	162,326	9.9	14.7
1930	1,083,511	105,618	155,437	9.7	14.3
1931	1,027,274	86,087	123,873	8.4	12.1
1932	938,757	74,494	103,198	7.9	11.0
1933	975,214	45,394	106,526	4.7	10.9
1934	1,034,672	50,494	114,276	4.9	11.0
1935	1,112,672	52,635	128,638	4.7	11.6
1936	1,224,748	57,104	131,545	4.7	10.7
1937	1,342,516	57,157	172,346	4.3	12.8
1938	1,330,850	54,308	193,476	4.1	14.5
1939	1,420,035	59,060	188,673	4.2	13.3
1940	1,457,086	83,751	130,466	5.7	9.0
1941	1,594,609	97,142	108,830	6.1	6.8
1942	1,566,815	35,966	116,907	2.3	7.5
1943	1,671,383	63,412	149,957	3.8	9.0
1944	1,878,673	92,256	208,911	4.9	11.1
1945	1,952,140	113,373	184,273	5.8	9.4
1946*	1,940,000	133,700	156,000	6.9	8.0
Pre-war—1935-39 average				4.4	12.7

*Projected for full year, based upon actual data for 7 months.
†Estimated—Actual figures not available.

Imports and exports related to demand.





Trend of imports and exports.

the average ratio of crude oil imports to domestic production was 2.6 per cent. This year the ratio will be in the order of 5 per cent imports to crude production. Although the volume of crude oil imports is substantially greater than it was in prewar years, it is interesting to compare this year's imports with the projected demand for all oils. With a demand this year for all oils of 1,940,000,000 bbl., crude oil imports represent a ratio of about 4.5 per cent. By comparison the ratio of crude oil imports to demand in the prewar years was shown to be 2.6 per cent. Whether or not this is a serious increase, consideration should be given to the fact that many of the large companies operating in South America and in the Middle East find it necessary to bring into this country certain types of crude oils from which they produce specialty products by refining that are not available in sufficient quantities in the United States.

TABLE 2
U. S. petroleum imports and exports situation

Year	Crude oil imports	Refined oils imports	Total imports	Crude oil Exports	Refined oils Exports	Total Exports	Total imports, per cent of exports
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1918	37,736	1,227	38,963	5,884	62,128	68,012	57.3
1919	52,822	1,376	54,198	6,348	57,500	63,848	84.9
1920	106,175	2,647	108,822	9,295	70,281	79,576	136.8
1921	125,364	3,428	128,792	9,627	62,025	71,652	179.7
1922	130,255	5,719	135,974	10,805	63,539	74,344	182.9
1923	82,015	17,638	99,653	17,534	84,447	101,981	97.7
1924	77,775	16,806	94,581	18,239	98,905	117,144	80.7
1925	61,824	16,376	78 200	13,337	100,497	113,834	68.7
1926	60,382	20,938	81,320	15,407	116,543	131,950	61.6
1927	58,383	13,353	71,736	15,844	125,805	141,649	50.6
1928	79,767	11,790	91,557	18,966	135,483	154,449	59.3
1929	78,933	29,777	108,710	26,401	135,925	162,326	67.0
1930	62,129	43,489	105,618	23,705	131,732	155,437	67.9
1931	47,250	38,837	86,087	25,535	98,338	123,873	69.5
1932	44,682	29,812	74,494	27,393	75,805	103,198	72 2
1933	31,893	13,501	45,394	36,584	69,942	106,526	42 6
1934	35,558	14,936	50,494	41,127	73,149	114,276	44.2
1935	32,239	20,396	52,635	51,430	77,208	128,638	40.9
1936	32,327	24,777	57,104	50,313	81,232	131,545	43.4
1937	27,484	29,673	57,157	67,234	105,112	172,346	33.2
1938	26,412	27,896	54,308	77,254	116,222	193,476	28.1
1939	33,095	25,965	59,060	72,076	116,597	188,673	31.3
1940	42,682	41,089	83,751	51,496	78.970	130,466	64.2
1941	50,606	46,536	97,142	33,238	75,592	108,830	89.3
1942	12,297	23,669	35,966	33,834	83 073	116,907	30.8
1943	13,833	49,579	63,412	41,342	108.615	149,957	42.3
1944	44,805	47,451	92,256	34,238	174,673	208,911	44.2
1945	74,095	39,278	113,373	32,998	151,275	184,273	61.5
1946*	86,500	47,200	133,700	32,500	123,500	156,000	85.7
Pre-war—1935-39 average							34.4

*Projected for full year, based upon actual data for 7 months.

Table 3 shows the relationship between crude oil imports and United States crude production as well as total imports of all oils in relationship to crude production. It will be noted that total imports of all oils this year constitute 7.8 per cent of the United States crude production, which compares with a ratio in the prewar years of 4.8 per cent. In comparing total imports this year with prewar years in relationship to crude production it should be noted that a substantial share of the refined oils imported this year is classed as residual fuel oil. Both of these factors must be considered in the light of today's domestic and foreign requirements for heavy oils as well as specialty products to be determined whether the volume of imports is too far out of line with relationships that existed in the five prewar years, 1935-39.

Today's marine tonnage afloat on the high seas is greater than at any time in history, with perhaps three-fourths of the world's ships being operated on oil. As a result, bunker fuel oils are in heavy demand all over the world. Studies of bunker fuel consumption at principal ports of call in foreign and domestic markets reveal substantial increases over prewar years. Gains in bunker fuel oil consumption of 200 to 300 per cent over prewar are not uncommon.

Heavy crudes possessing desired residual fuel oils are produced and refined in South America. Yields of residual fuel oil from Venezuelan crudes average

70 per cent or more per barrel processed. The heaviest movements of such products are from Venezuela and the Netherlands West Indies. Most of the residual fuel oil imported into the United States this year comes from this area. Few crude oils produced in the United States yield such substantial quantities of residual fuel oil. Economically, American oil producers stand to benefit in the long run by such importations, for light crudes produced here may be depended upon to provide the growing world demand for high grade motor fuels and lubricants. These are the products that dictate the market value of American crude oil.

Crude oil imports this year are expected to constitute about 5.1 per cent of U. S. refinery runs to stills. U. S. still runs this year will aggregate about 1,723,000,000 bbl., with foreign crude imports of 86,500,000 bbl. In the prewar period, 1935-39, as shown in Table 4, the ratio of crude imports to refinery runs was at an average of 2.7 per cent. Although this, again, represents a substantial increase over the prewar period, the larger ratio is qualified by economic conditions that call for the importation of certain types of foreign crudes required for the manufacture of specialty products. Imports of all refined products this year are expected to be in the ratio of 2.7 per cent of U. S. refining operations. This compares with 2.3 per cent imports to average annual refinery runs in the prewar period 1935-39. In consideration of residual fuel oil imports as a necessary supplement to supplies provided by our own refining operations, the relationship of refined products imports to U. S. refining operations seems to be equitable and in line with the overall economic supply and demand picture.

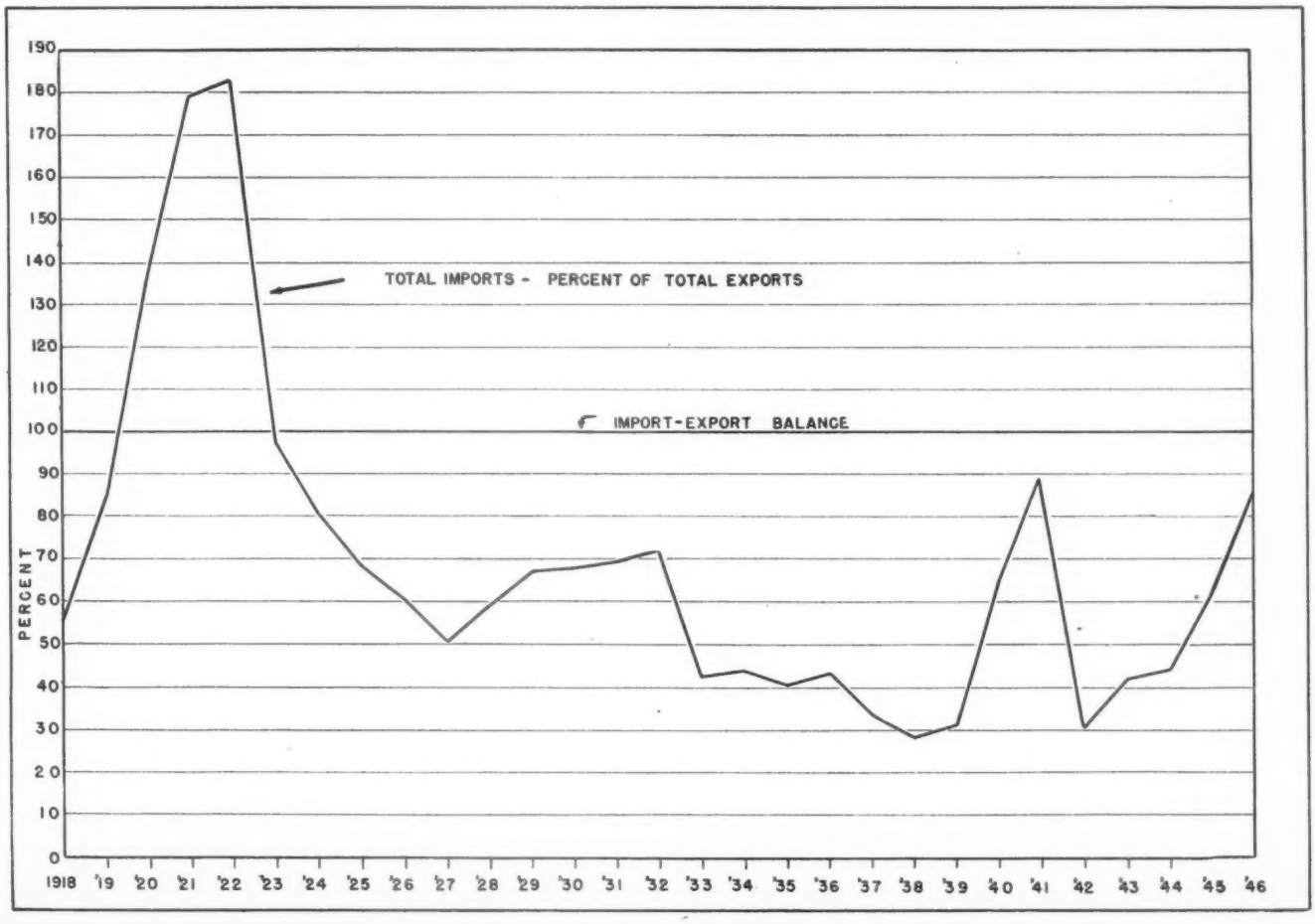
World crude oil production this year is expected to be about 425,000 bbl. a day greater than in 1945. Most of the increase will be contributed by Venezuela, Iran, and Arabia. Venezuela is now pro-

TABLE 3
Imports related to crude oil production

Year	U. S. crude production	Crude oil imports	Total imports	Crude imports, per cent of production	Total imports, per cent of U. S. crude production
	(1)	(2)	(3)	(4)	(5)
1918	355,928	37,736	38,963	10.6	10.9
1919	378,367	52,822	54,198	14.0	14.3
1920	442,929	106,175	108,822	24.0	24.6
1921	472,183	125,364	128,792	26.5	27.3
1922	557,531	130,255	135,974	23.4	24.4
1923	732,407	82,015	99,653	11.2	13.6
1924	713,940	77,775	94,581	10.9	13.2
1925	763,743	61,824	78,200	8.1	10.2
1926	770,874	60,382	81,320	7.8	10.5
1927	901,129	58,383	71,736	6.5	8.0
1928	901,474	79,767	91,557	8.8	10.2
1929	1,007,323	78,933	108,710	7.8	10.8
1930	898,011	62,129	105,618	6.9	11.8
1931	851,081	47,250	86,087	5.6	10.1
1932	785,159	44,682	74,494	5.7	9.5
1933	905,656	31,893	45,394	3.5	5.0
1934	908,065	35,558	50,494	3.9	5.6
1935	996,596	32,239	52,635	3.2	5.3
1936	1,099,687	32,327	57,104	2.9	5.2
1937	1,279,160	27,484	57,157	2.1	4.5
1938	1,214,355	26,412	54,308	2.2	4.5
1939	1,264,962	33,095	59,060	2.6	4.7
1940	1,353,214	42,662	83,751	3.2	6.2
1941	1,402,228	50,606	97,142	3.6	6.9
1942	1,386,645	12,297	35,966	0.9	2.6
1943	1,505,613	13,833	63,412	0.9	4.2
1944	1,677,753	44,805	92,256	2.7	5.5
1945	1,711,103	71,095	113,373	4.3	6.6
1946*	1,720,000	86,500	133,700	5.0	7.8
Pre-war—1935-39 average				2.6	4.8

*Projected fo full year, based upon actual data for 7 months.

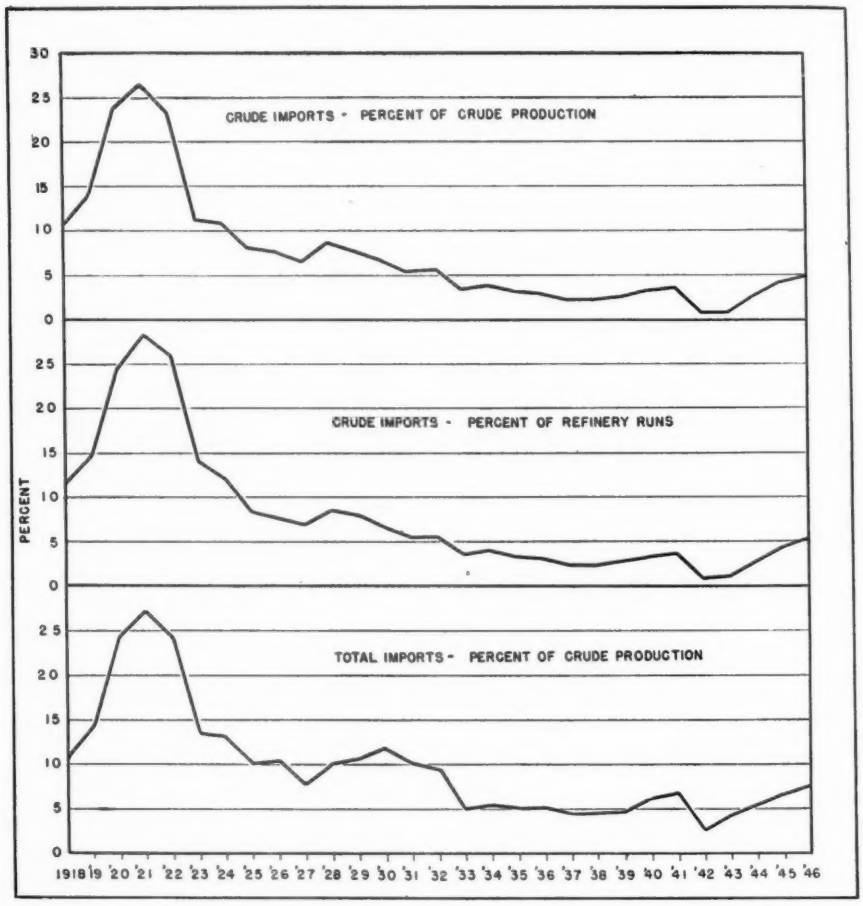
Imports—per cent of exports.



ducing 1,250,000 bbl. daily and fields of the Middle East have stepped up their production to nearly 600,000 bbl. daily. These areas will account for at least 400,000 bbl. a day of the world's increased crude production this year, compared with 1945. U. S. crude production may finally show an increase over last year of about 25,000 bbl. daily. These figures give some idea of what is happening with respect to the oil supply picture outside the United States. They point definitely to vastly greater potential supplies of foreign oil, which cannot fail to affect near-future foreign outlets for American oil.

Much of the crude produced outside the United States, which is definitely destined to grow in volume, will be refined at strategic refining and distribution centers abroad. As the demand for petroleum products increases in response to growing world requirements, it can be expected that more and more petroleum products will probably be supplied by foreign sources. This may mean that the United States will not be able to maintain its world position as a net exporter of crude oil and products.

When economic conditions in the rest of the world are again restored to a reasonable state of normalcy, and when civilian and industrial demands for petroleum products resume their long upward trend, consumption of light petroleum products and lubricants, as well as specialty products, should place American producers and refiners of crude oil in a decidedly favorable economic position. High gravity crudes, which are not so plentiful elsewhere as they are in the United States, will offer profitable markets for aviation gasolines, motor fuels, lubricants, and specialty products produced here. Heavier products, such as residual fuel oils and asphalt, available in large quantities from foreign crudes, may be expected to provide such deficiencies as may be created by concentration of effort to the manufacture of the more valuable products. This may mean, however, that imports of heavy products and special types of crude oils into the United States will more than offset the exports of light oils and specialty products produced here.


CRUDE IMPORTS - PERCENT OF CRUDE PRODUCTION
CRUDE IMPORTS - PERCENT OF REFINERY RUNS
TOTAL IMPORTS - PERCENT OF CRUDE PRODUCTION
PERCENT
30
25
20
15
10
5
0
1918 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46

Imports related to crude production and to refinery operations.

Projections into the future, say over the next 10 or 15 years, point quite definitely to the probability that the United States will become a net importer of petroleum and its products. The trend of demand is definitely upward in the years ahead and this is bound to have a marked effect upon America's foreign trade in petroleum and its products. As demand for American petroleum products increases, the volume of imports may likewise increase, but whether the ultimate effect will be deleterious, will depend on whether importers of foreign crude and products adhere to a policy of importing heavy oils and specialty type crudes.

Concentration of the American petroleum industry upon the manufacture of high grade light products and specialties and dependence upon foreign sources for heavy products may offer a sound future program for the industry to follow. If the value of American petroleum products exported exceeds the value of foreign oil imports, we may continue to be a so-called exporter nation. Thus, although the United States may become an importer from a volumetric standpoint, it is also quite likely that we may continue to be net exporters from a monetary standpoint. ★★★

TABLE 4
Imports related to refining operations

Year	U. S. refinery runs	Crude oil imports	Refined oil imports	Crude imports, per cent of refinery runs	Refined imports, per cent of refinery runs
	(1)	(2)	(3)	(4)	(5)
1918	326,025	37,736	1,227	11.6	0.4
1919	361,520	52,822	1,376	14.6	0.4
1920	433,915	106,175	2,647	24.5	0.6
1921	443,363	125,364	3,428	28.3	0.8
1922	500,706	130,255	5,719	26.0	1.1
1923	581,238	82,015	17,638	14.1	3.0
1924	643,719	77,775	16,806	12.1	2.6
1925	739,920	61,824	16,376	8.4	2.2
1926	779,264	60,382	20,938	7.7	2.7
1927	828,835	58,383	13,353	7.0	1.6
1928	913,295	79,767	11,790	8.7	1.3
1929	987,708	78,933	29,777	8.0	3.0
1930	927,447	62,129	43,489	6.7	4.7
1931	894,608	47,250	38,837	5.3	4.3
1932	819,997	44,682	29,812	5.4	3.6
1933	861,254	31,893	13,501	3.7	1.6
1934	895,636	35,558	14,936	4.0	1.7
1935	965,790	32,239	20,396	3.3	2.1
1936	1,068,570	32,327	24,777	3.0	2.3
1937	1,183,440	27,484	29,673	2.3	2.5
1938	1,165,015	26,412	27,896	2.3	2.4
1939	1,237,840	33,095	25,965	2.7	2.1
1940	1,294,162	42 662	41,089	3.3	3.2
1941	1,409,192	50,606	46,536	3.6	3.3
1942	1,334,103	12,297	23,669	0.9	1.8
1943	1,429,738	13,833	49,579	1.0	3.5
1944	1,665,684	44,805	47,451	2.7	2.8
1945	1,719,534	74,095	39,278	4.3	2.3
1946*	1,723,000	86,500	47,200	5.1	2.7
Pre-wa —1935-39 average				2.7	2.3

*Projected for full year, based upon actual data for 7 months.

Technology factor in S. A. oil development

By **WALLACE A. SAWDON,**
Editor of *Petroleo*

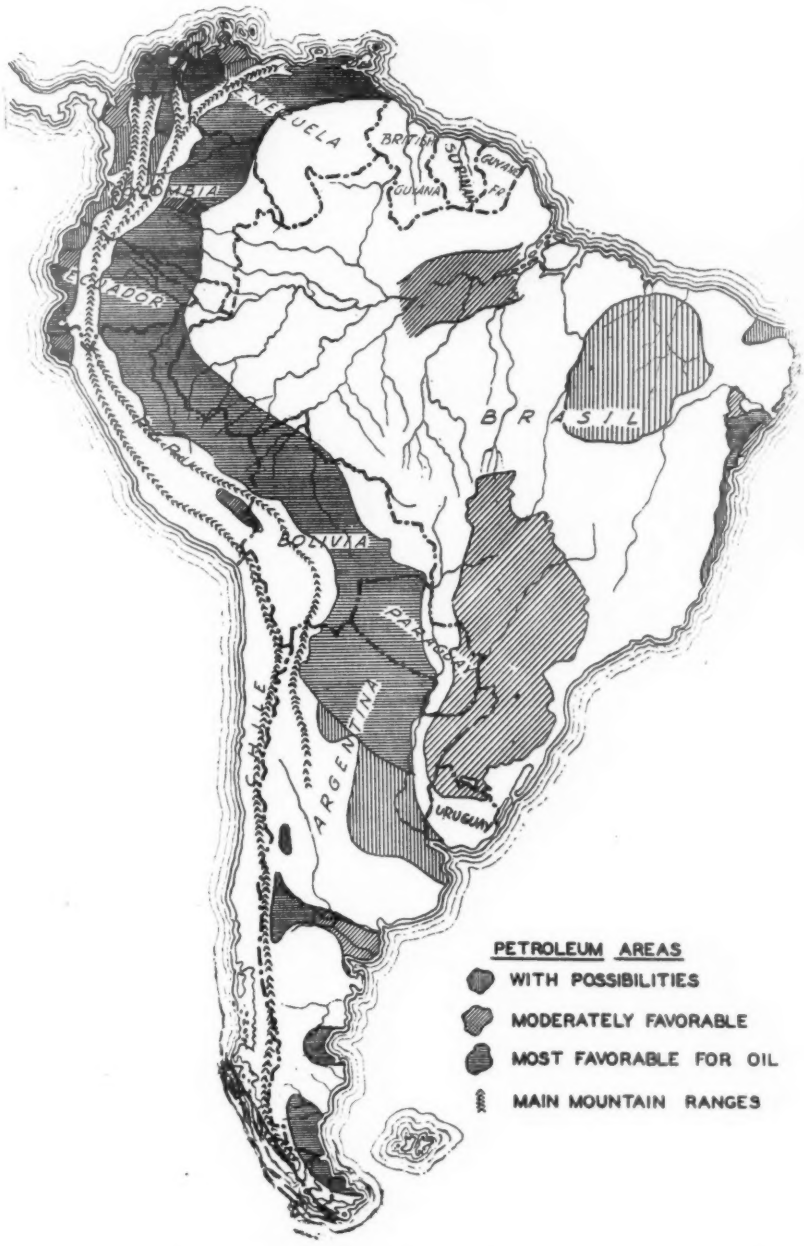
EXCLUSIVE

THE South American continent already plays an important part in the world's oil industry; but when its present output of oil is compared with its possible production, the magnitude of its future influence can only be surmised. Much of this future production is hard to reach and presents difficulties for transportation; but areas once considered too difficult to develop are now producing vast quantities of oil, which are being piped to tidewater and shipped to points all over the world. Oil lying many miles from shore under the waters of Lake Maracaibo has been an important source of supply for many years; fields situated deep in the interior of Eastern Venezuela and far up the valley of the Magdalena River in Colombia have been discovered and developed; a field behind the mountains in Peru indicates the possibility of the great area just east of the Andes; and a well drilling in the Gran Chaco of Paraguay lies in about the middle of the continent. The tremendous petroleum potentialities of South America are rapidly being approached from all sides.

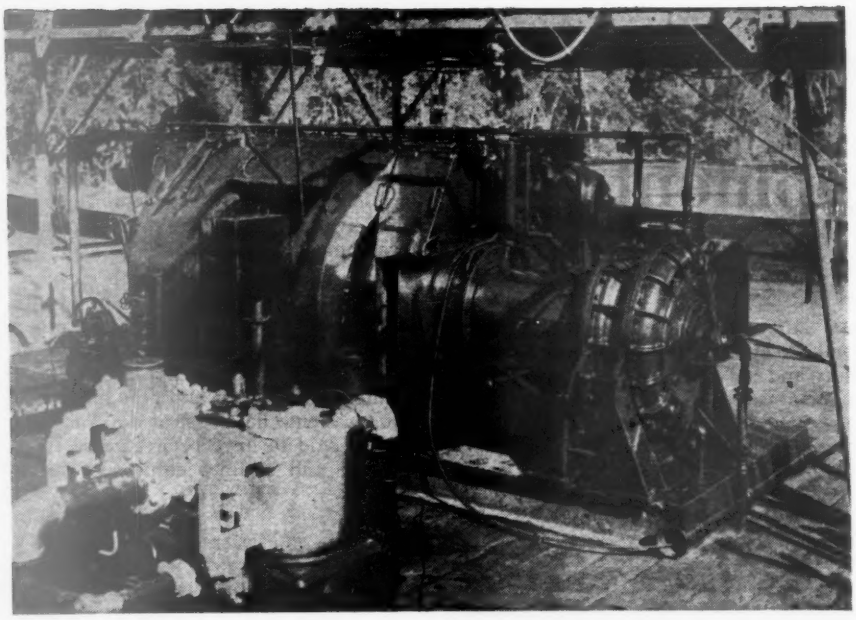
Difficulties tax the ingenuity of man and require the application of the most advanced technique. The oil industry has become highly scientific and is now able to cope effectively with the problems imposed by many areas of the South American Continent. Oil equipment has been developed to meet these problems as they arise and methods of using oil tools and machinery most efficiently have been developed as a result of long experience. American manufacturers can supply the equipment to meet any condition that may exist in the vast areas of South America and it is up to the operators in those areas to apply the tools to the individual conditions. But because of the difficulties that attend many of the operations it is necessary to use the most advanced technique and the most modern designs of equipment if operations are to be conducted with maximum efficiency and greatest economy. That is exactly what is being done throughout the various countries of South America, with the result that this continent has a future that is no longer merely potential.

● **Consider first exploratory operations.** The advancement in geophysical procedures has been the means of covering extensive areas that could not have been surveyed under the conditions found except with the greatest of difficulty and the lapse of a very long time. In some cases it is doubtful whether surveys could have been made by geological means alone. This does not mean that geological work is not being conducted prior to exploratory drilling, because geological crews are continuously at work in various areas. Moreover, subsurface geology is one of the very important factors in the location of production; and geological technology is extensively employed in drilling procedure. Coring and core analysis are utilized to excellent advantage with core laboratories available to both exploratory and development operations.

The airplane probably has been more of a factor in the development of the South American areas than in any other place in the world. It has been used from the reconnaissance period to the maintenance of wells and pipe lines. The Agua Caliente field east of the Andes in Peru is said to have been located from the air; and drilling equipment for a



Many geological maps of the South American continent show different prospective petroleum areas but all of them agree very closely in the general outlines. The geological data shown on this map are taken from one presented by Professor John L. Rich of the University of Cincinnati in his paper "Petroleum Possibilities of South America," published in A.A.P.G. Bulletin, Vol. 29, No. 5.



made for units in others. The most modern equipment must naturally be used for this new refinery expansion and the designs developed during the last few years will be installed.

● **Drilling and production operations.** Although the statement is extremely general, operation methods follow closely the most advanced technique developed in the United States. This is entirely natural because oil equipment and services are developed in this country to meet virtually every condition that is found and American equipment is most widely used to conduct operations. In fact, many of the special tools employed in drilling operations can be obtained nowhere else. Manufacturers of equipment are therefore under obligation to acquaint South American operators fully of the construction and operation of their equipment and to provide as much information as possible on how it can be used most efficiently. This information should reach the man in the field and plants because thorough knowledge of the tools with which he works is essential to their proper performance.

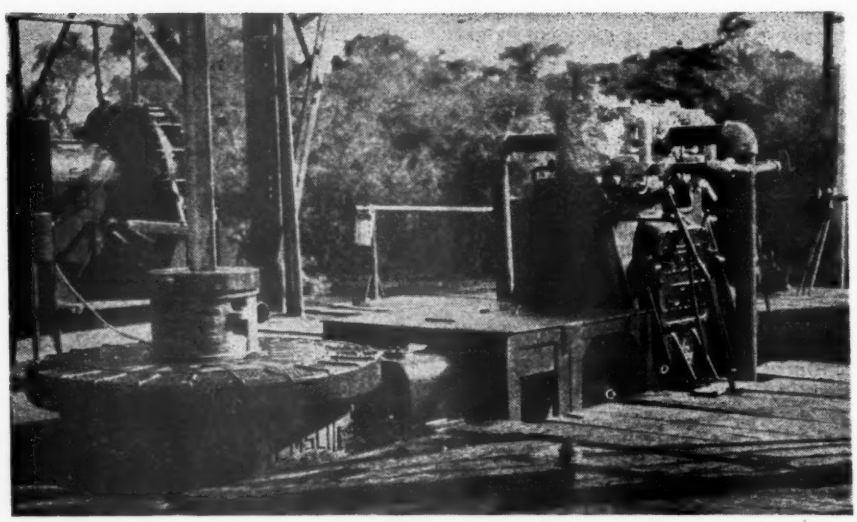
The difficulties that must be surmounted in many South American areas have naturally led to the use of the most modern equipment and the employment of the most advanced technique. Mistakes are more costly under such conditions. Continuous study of how things are done in other areas or other countries where similar problems have been met can serve as a guide. But individual problems must be given the same consideration as in every oil producing area of the world and in many cases new techniques that have since been applied elsewhere have originated in some of the South American operations.

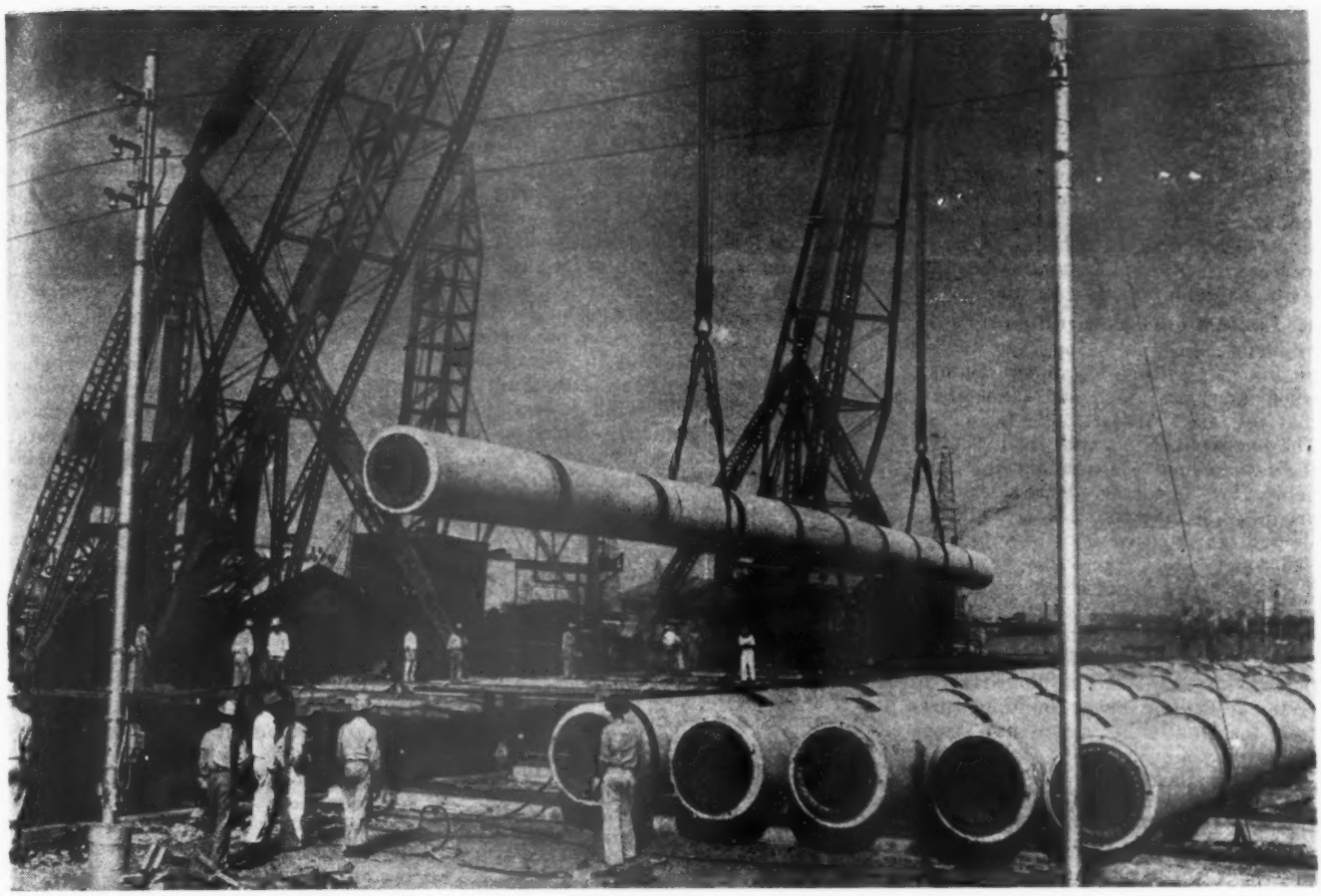
Subsurface practices for different areas are naturally developed to meet

Drawworks and rotary table at Cabimas, Venezuela, the deepest well yet drilled in South America. The drawworks is modern design heavy duty type, driven by a 12 by 12 vertical steam engine. Rotary table is driven by a 10 by 8 vertical steam engine.

well in the llanos region of Colombia was flown in by plane.

In considering the airplane as a factor in South American petroleum operations, it must be remembered that it is a two-way proposition. The main routes of travel, especially north of Patagonia, are in the air. The character of the country necessitates this. Although the whole continent is already traversed by a network of airplane routes, the amount of air travel will increase tremendously. Aviation fuel for carrying on this transportation must therefore be much more readily available than it is at the present time, which means that refinery construction in South America will have to be done to provide for this fuel. This has, of course, been foreseen and high octane plants are already under construction in some countries and definite plans



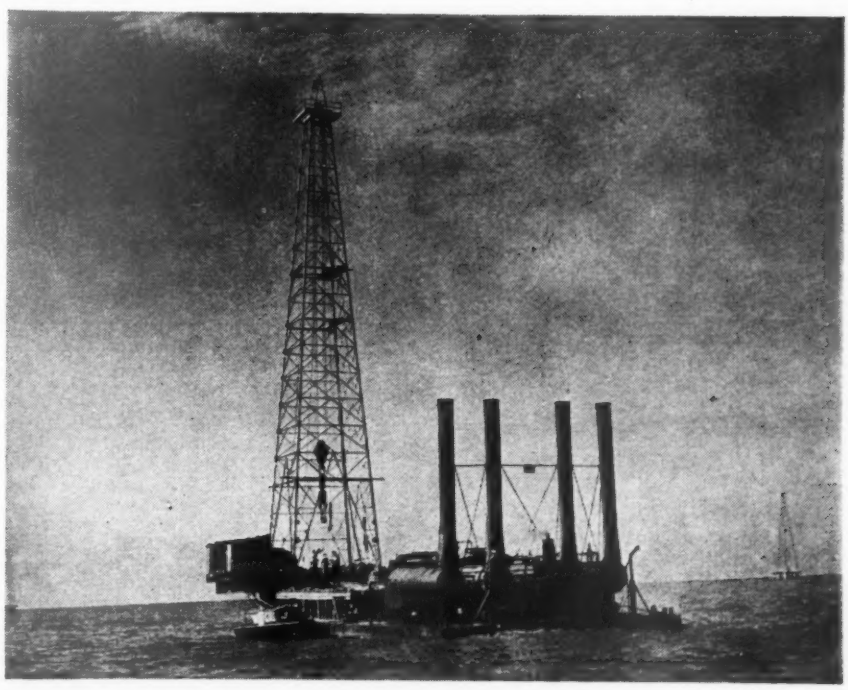


Operation on Lake Maracaibo requires concrete pile foundations. An extensive plant for construction of the reinforced piles is a big project in itself. Above is a 150-ft. pile of the caisson type being loaded onto a barge for transportation.

formation conditions found in the particular area. Formational data are obtained by coring and electrical logging, and underground studies have been particularly thorough in the recently discovered areas. In cases like that of the Lake fields where different operators are producing the same fields, an exchange of subsurface data has aided greatly in the effective development of the reservoirs. Cementing practices have been given particular attention where series of producing zones have been found and all the modern tools for the placement of cement have been utilized to advantage.

Well depths naturally vary over a wide extent when considering the many different producing areas spread out over this vast continent. The deepest hole drilled in South America to date reached a little below 13,000 ft. before operations were suspended about a year ago. The well is Venezuelan Oil Concessions, Ltd., R-801 in the Cabimas field, which is one of the northerly Lake fields of the Maracaibo Basin. The modern heavy-duty equipment employed on this well is indicative of what will probably be used for deep drilling operations. The derrick was 136 ft. in height with a 30-ft. base. The rotary table was individually driven by a vertical steam engine. Two 18 by 8 by 20 mud pumps provided circulation and two smaller pumps were used for mud mixing and circulation of the drilling fluid through cooling pits, the mud coming from the well being of high temperature. The hook was the 300-ton type and other rig

Below is a well being drilled on Lake Maracaibo. The derrick is built on the pile foundation structure and the engine-drawworks unit extends over the water on a cantilever platform. The drilling barge supplies the steam, provides the mud ditch, carries the pipe rack and takes care of everything not on the conventional derrick floor. Mud to and from the hole passes between the barge and well through rubber hose.



equipment was in proportion. The very latest design of drawworks, rotary machine, and other equipment was employed.

Both steam and power rigs are widely used and in some cases electric motors are employed. There is a tendency toward a greater use of internal-combustion engines for drilling. Also, the portable type of drilling rig is being given increased consideration and is particularly adaptable to many locations.

● **Unusual surface problems.** Many problems of large scope that involve planning for the complete operation of a whole area have been met; and others that will arise similarly will be solved. The outstanding example is, of course, the development of the Maracaibo Lake fields. Here is a case where a series of producing fields practically straddle the shore of an extensive body of water. Unlike other fields where the reservoir hugs the shore to some extent, a great productive area lies for several miles off shore with wells to date being drilled as far as nine miles away from land. Such fields cannot be developed by directional drilling or by building piers from the land. Other means have to be employed.

In these Lake fields, the land areas are operated by the Venezuelan Oil Concessions, Ltd., and are developed in the usual manner. Along the shore, but on the water, are strips one kilometer in width that are operated by the Mene Grande Oil Company. These are developed mainly by wells on piers with connections to the land. The remainder of the productive areas that lie below the waters of the lake are held by Creole Petroleum Corporation and require entirely different methods for drilling and production.

An extensive organization had to be built up to drill and produce these Lake wells. The project required careful planning and engineering skill. Each well is placed on a man-made island, which is constructed on concrete piles. For the operations in the shallower water, solid, square, reinforced piles are used; but for the deeper water the structures have to be erected on hollow concrete piles of a caisson type as shown in accompanying illustrations. Compressor stations, gathering stations, gasoline plants, repressuring plants, and other smaller structures are also built on the concrete piling—each a small island on a broad expanse of water. Because production operations are powered by electricity, power lines have been constructed throughout the fields with towers supporting the lines similarly erected on the water.

All drilling operations (as shown in the illustrations) are conducted from barges and all transportation between wells and other structures and land is by boats and barges of various types. Pipe lines are laid on the floor of the lake and carry the crude oil, gas, and gasoline to land.

The only other off-shore production of any great extent in South America at the present time is at Comodoro Rivadavia in Argentina. Here many wells are drilled from piers built out into the Gulf of St. George and others extending beyond the shore are put down by directional drilling. There are prospects of other areas where wells will have to be drilled and produced from water-covered locations. The technique to be followed naturally will be governed by the conditions found and the experience already gained will be utilized to great advantage.

● **Conservation measures.** A great many of the producing areas of South America are operated by single organizations; so what we know as "unit operation" is almost automatic. This has been a factor in greater efficiency in producing methods. There is frequently no market for gas, but instead of being an excuse for wastage of gas, this fact has led to the early installation of repressuring plants. Many of the old fields in several countries of South America probably owe their present productive capacity to these conservation measures. Gasoline is extracted from the wet gas to the greatest extent possible.

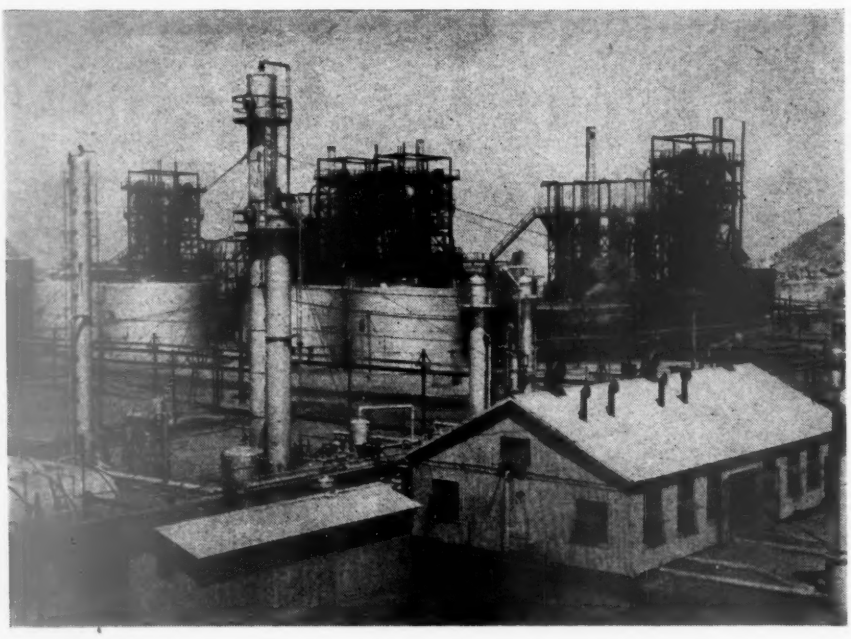
In the newer areas, such as those of Eastern Venezuela, pressure maintenance is being given great consideration. Some pressure maintenance plants are already in operation and more probably will be constructed as soon as possible. These plants are and will be of the most modern design and will combine natural gasoline extraction with pressure maintenance operations.

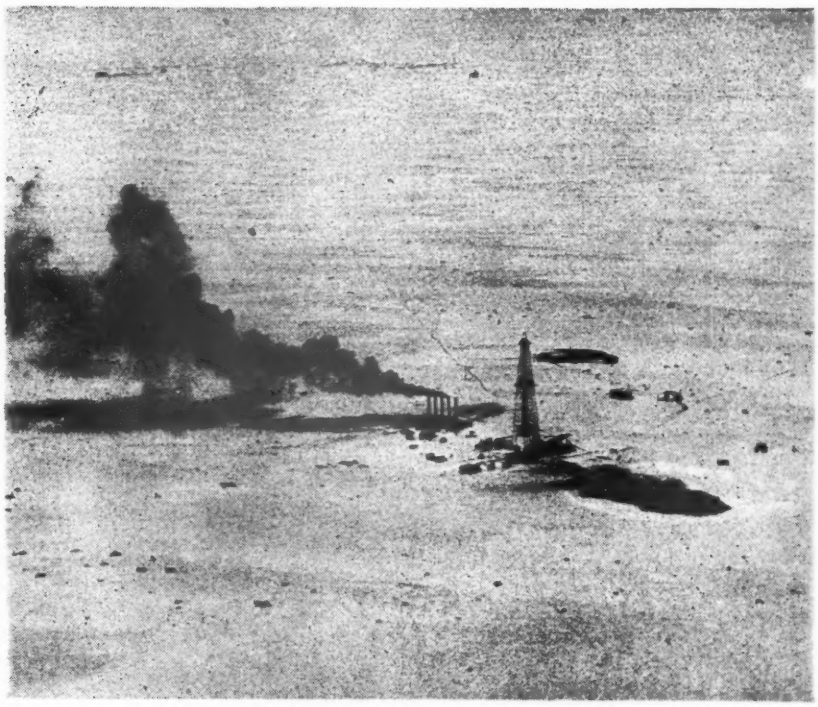
● **Refining.** Due to the great volume of crude oil that has been exported from the mainland of the continent, refining capacity has not been great when compared to the amount of oil produced. A number of thermal cracking units are in operation in various countries but it was not until recent months that catalytic cracking could be considered, mainly because equipment has not been available. Refining technique within the limits imposed by circumstances was, however, very good and constant improvement was carried on as the technology developed. Now, however, a number of catalytic cracking units are being constructed or are planned as part of the great refinery expansion program that is taking shape at strategic points throughout the South American Continent. In this program is provision for the manufacture of aviation gasoline, which has already become a necessary product. Although the passenger service of airplanes is predominant at the present time, the very character of the country points to the necessity of utilizing air transportation for the shipment of goods; and this requires fuel.

In Venezuela alone, a 40,000-bbl. refinery is being constructed by the Shell interests and erection of a 60,000-bbl. refinery is about to be started by Creole Petroleum Corporation. Both are complete plants and are situated on the Paraguana Peninsula that juts out into the Caribbean Sea from the northern coast of Venezuela east of the entrance to Lake Maracaibo. A pipe line is to be built from the Lake fields to carry crude to this refining center. Equipment for this line is now being purchased. Another large refinery is contemplated by the Sinclair interests, which have recently completed an extensive pressure maintenance and natural gasoline extraction project in Eastern Venezuela. Other refinery programs, consisting of new construction and/or expansion of existing plants, are planned in Colombia, Peru, Bolivia, and Argentina. Although not confirmed, there are reports of the probable construction of a complete refinery in Brazil in the near future. Meanwhile modernization of existing refining facilities is being carried on in many places throughout the continent.

★★★

Absorption plant showing cracking units, Talara, Peru.



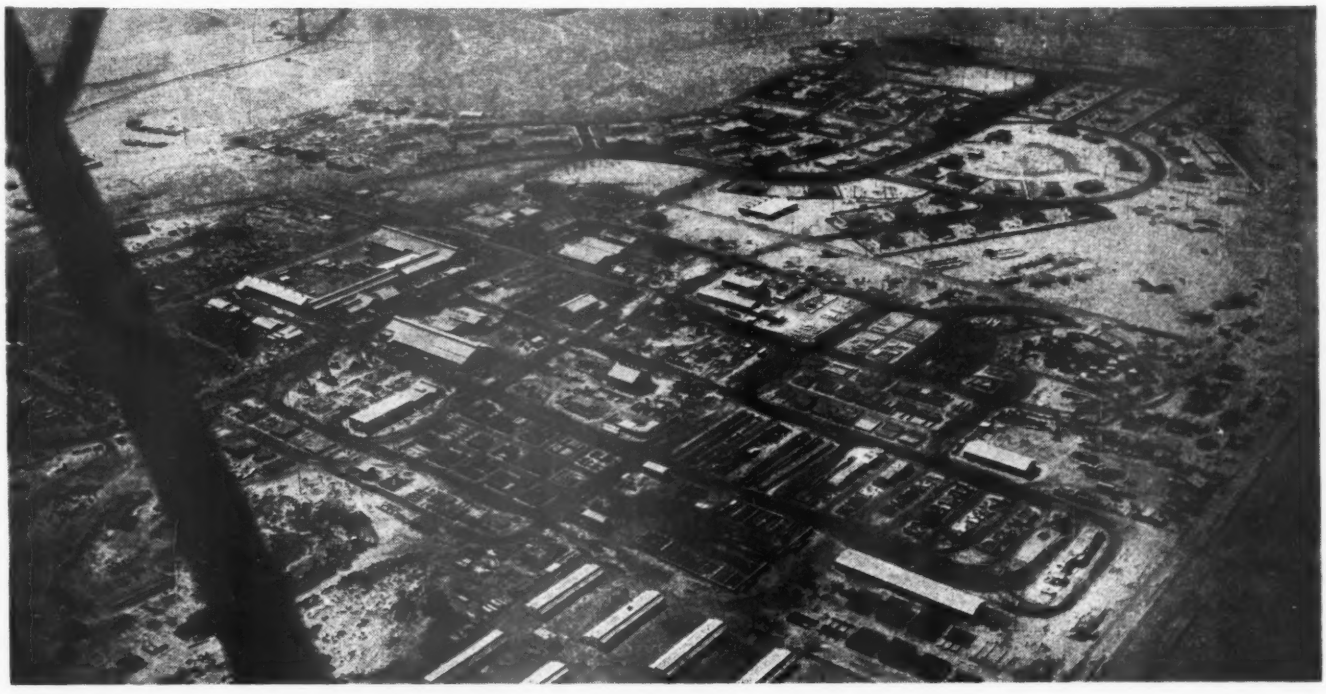


PHOTOS BY RICHIE FOR ARABIAN AMERICAN OIL COMPANY.

Arabian American Oil Company's field at Abqaiq whose limits have not been discovered although nearly 23,000 acres have been found productive. Wells are spaced two miles apart and communication between them is by radio telephone rather than land wires because of shifting sands.

Bonanza fields of Saudi Arabia

Aerial view of the Arabian American Oil Company's headquarters' community at Dhahran, in the heart of the producing field of Dammam where oil was first found in Saudi Arabia. Oil rights are held 50-50 by Standard Oil Company of California and The Texas Company. Five strings of tools are being used in Arabia at Dammam, Qatif, and Abqaiq fields. The Abqaiq is the largest with a 2½ billion barrel recoverable reserve. Total Aramco production is nearly 200,000 barrels of oil a day.



Cooper-Bessemer

MOUNT VERNON, OHIO AND GROVE CITY, PENNA.

New York Washington Bradford, Pa. Houston, Dallas, Greggton, Pampa and Odessa, Texas Los Angeles Par

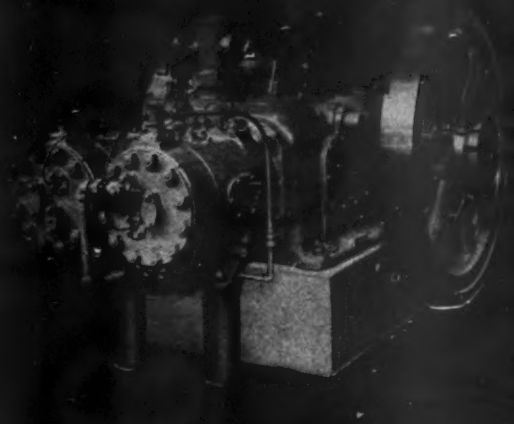
LOW COST POWER

to help you hold your profit margin

COOPER-BESSEMER ENGINES AND COMPRESSORS

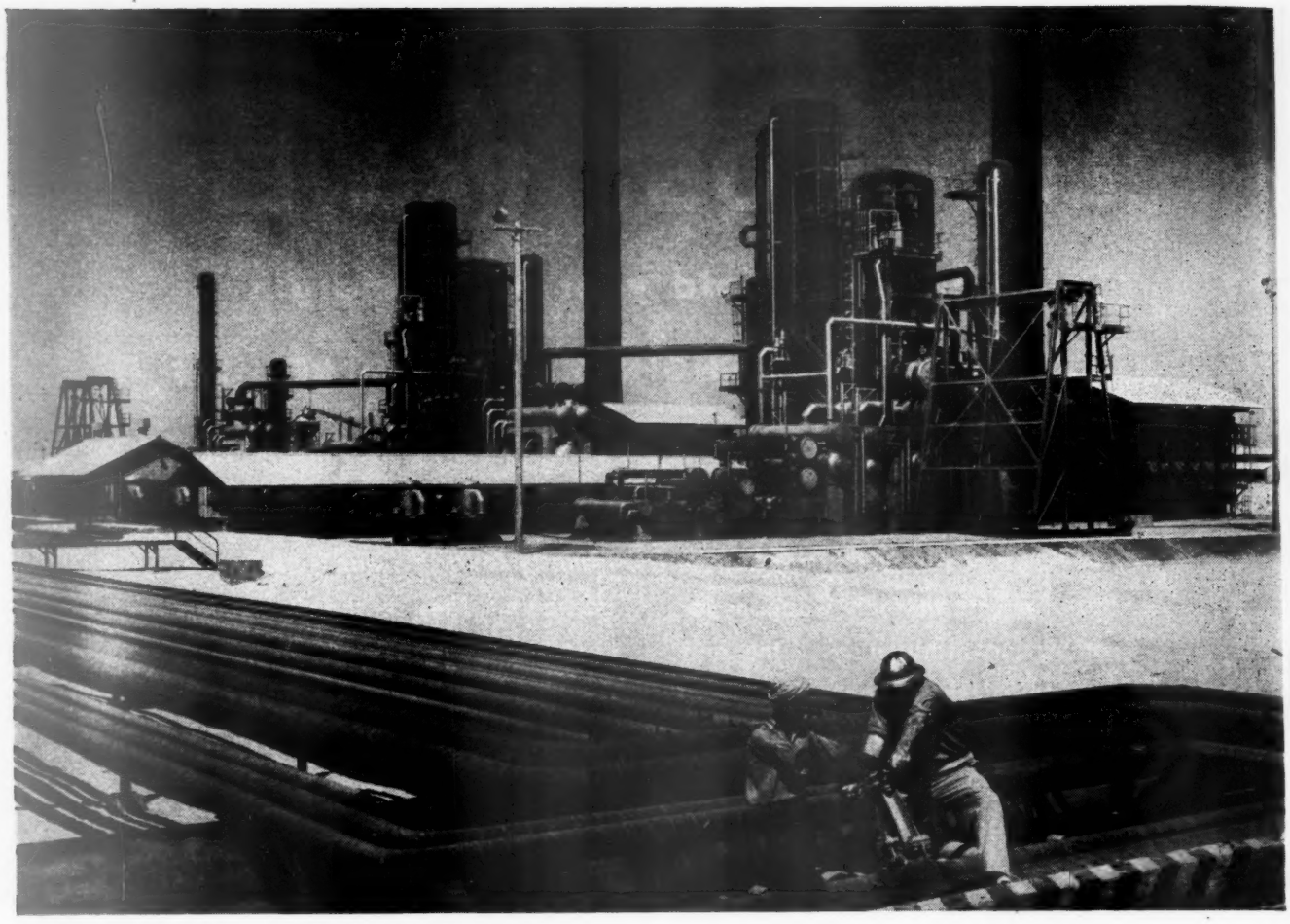
25 to 1650 horsepower

Higher efficiency! Greater output per dollar of production cost! These are of course the only weapons for combating inflation . . . the only way to offset higher labor and material costs. Here at Cooper-Bessemer we are producing engines and compressors noted for their high efficiency, for their exceptionally long life and economical operation. *They set the pace in low cost power!* Yes, if you are in the market for new or replacement power, you can count on efficient Cooper-Bessemers to help you hold your profit margin.



DIESEL · GAS · GAS-DIESEL ENGINES AND COMPRESSORS

Parkersburg, W. Va. San Francisco, Calif. Seattle, Wash. Tulsa Shreveport St. Louis Caracas, Venezuela

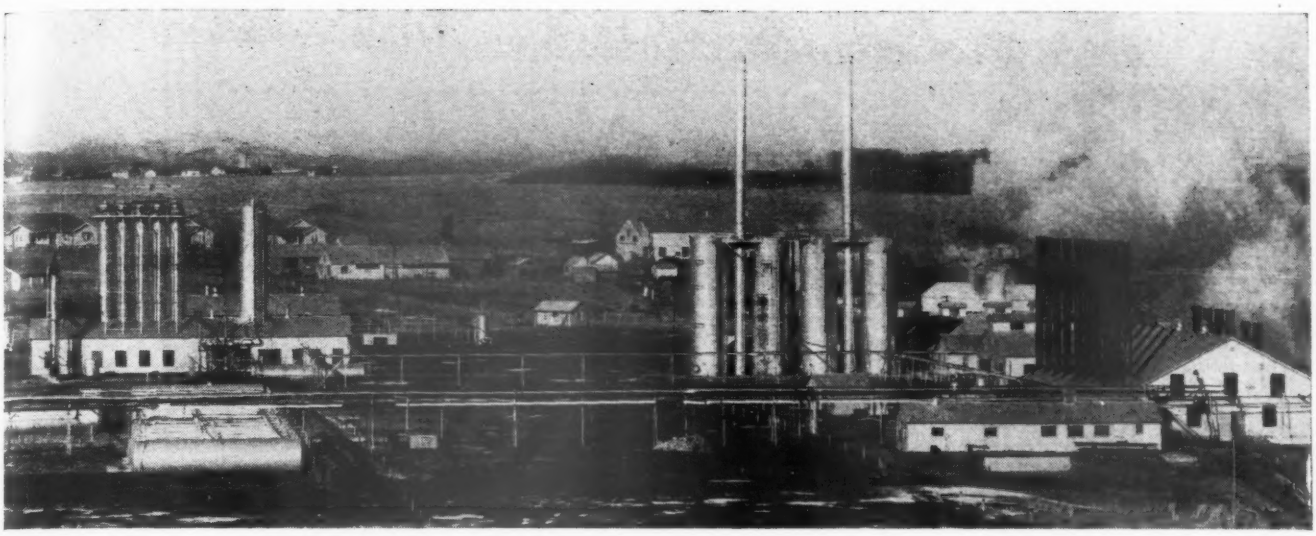


A view of Aramco's Ras Tanura refinery, on the Persian Gulf, 45 miles northeast of Dhahran. This $40,000,000 refinery was completed last autumn and is producing approximately 85,000 barrels per day of fuel oil, diesel oil and all purpose gasoline. Ras Tanura obtains its crude from two pipe lines connecting with producing fields in Dhahran and Qatif. A nearby marine terminal loads products into tankers at a rate of 10,000 to 12,000 bbl. per hour.

Production from the Dammam field is carried by pipe line to the refinery on Bahrein Island. Negotiations have been underway for some time by the Aramco to obtain a right-of-way across Arabia and Trans-Jordan for a pipe line to Mediterranean ports.

Products lines between the Ras Tanura refinery and the marine terminal on the Persian Gulf. Products are loaded at the rate of 10,000 to 12,000 bbl. per hour. Stabilized crude oil when shipped is loaded at a rate of 9000 bbl. per hour and the average tanker is loaded in 10 to 12 hours. Some of this output is being shipped to Europe. Widening markets are expected to increase greatly the production of Saudi Arabia fields and refineries in the next few years.

THE END



Turner Valley scrubbing plant and boiler house. Single large tower right of five scrubbers is a reactivator. Large towers with high stacks are actifiers and H_2S disposal unit.

Canadian developments—1946

By **FLOYD K. BEACH***

EXCLUSIVE

As OUTLINED in an article in this issue by Richard Sneddon, present Canadian oil production is centered in Alberta with minor production from Saskatchewan, Ontario, New Brunswick, and Northwest Territories. Hence the picture given in Fig. 1 showing the distribution of Alberta crude production through the war years tells a significant story.

The rise in the curve of civilian consumption of taxable products (gasoline and tractor distillate principally) was checked by gasoline rationing that began March 1, 1942, and 1942 saw about a 3 per cent decline in consumption from the previous year. Consumption was held steady in 1943, but in 1944 there was an increase despite rationing, and with the end of rationing promptly after VJ day in August, 1945, the whole year's consumption rose in the same curve as the previous year.

There was a general feeling in the minds of people whose consumption of gasoline was restricted by rationing, that the tremendous consumption by the armed forces, particularly through operation of the Empire Air Training Program and the construction of the Alaska Highway and Canol project, entailed even more gasoline consumption than civilian use. Figures obtained from the Alberta gasoline tax authorities since the end of the war, however, indicate that in 1943, when consumption by the armed forces was most active, civilian consumption was three times that of the armed forces, at least in Alberta.

Alberta sales of non-taxed oil have shown a large increase, much of which is attributable to the Vermilion field, whose production goes to the Canadian National Railway for locomotive fuel. This production amounted to about 235,000 bbl. in 1944, and slightly more in 1945, rising to that figure from a mere 11,000 bbl. in 1940, its first year of substantial production.

"Refining loss and stock adjustments" is an item arrived at by difference between known quantities, and if its amount is brought into the consumption picture in projecting future requirements, a false result may be obtained. It is known that stocks of crude oil, finished and partly finished products were up about 300,000 bbl. at the end of 1945 as compared with the close of 1944, and allowance for change in stocks would show that total Alberta requirements were about the same in 1945 as in 1944. After making this allowance and after appreciating the current increase in gasoline demand, one can project the declining production forward to the approximate date when Alberta will have no more oil available for export unless a new major field is discovered.

As a matter of interest, the production from wells financed by Wartime Oils is shown and marked WTO. Without the oil from these government financed wells, the curves of production and consumption would have met much the sooner.

The picture of distribution of Alberta crude production omits lubricants from the consumption, as no lubricants are manufactured in the province.

The Dominion Bureau of Statistics recently released a statement showing consumption of various grades of petroleum fuels, as shown in Table 1.

It will be noted that the national trends are much in line with those shown for Alberta in Fig. 1.

● **Turner Valley operations.** Turner Valley has been the predominant producer of oil for some years, and in producing oil it has wasted more than a trillion cubic feet of gas, but at the same time it marketed about 1/6 of a trillion cubic feet. Waste has been materially reduced through a succession of various angles of attack on the problem, and a comprehensive scheme of gas collecting mains and compressors now returns much of the gas to the producing zone.

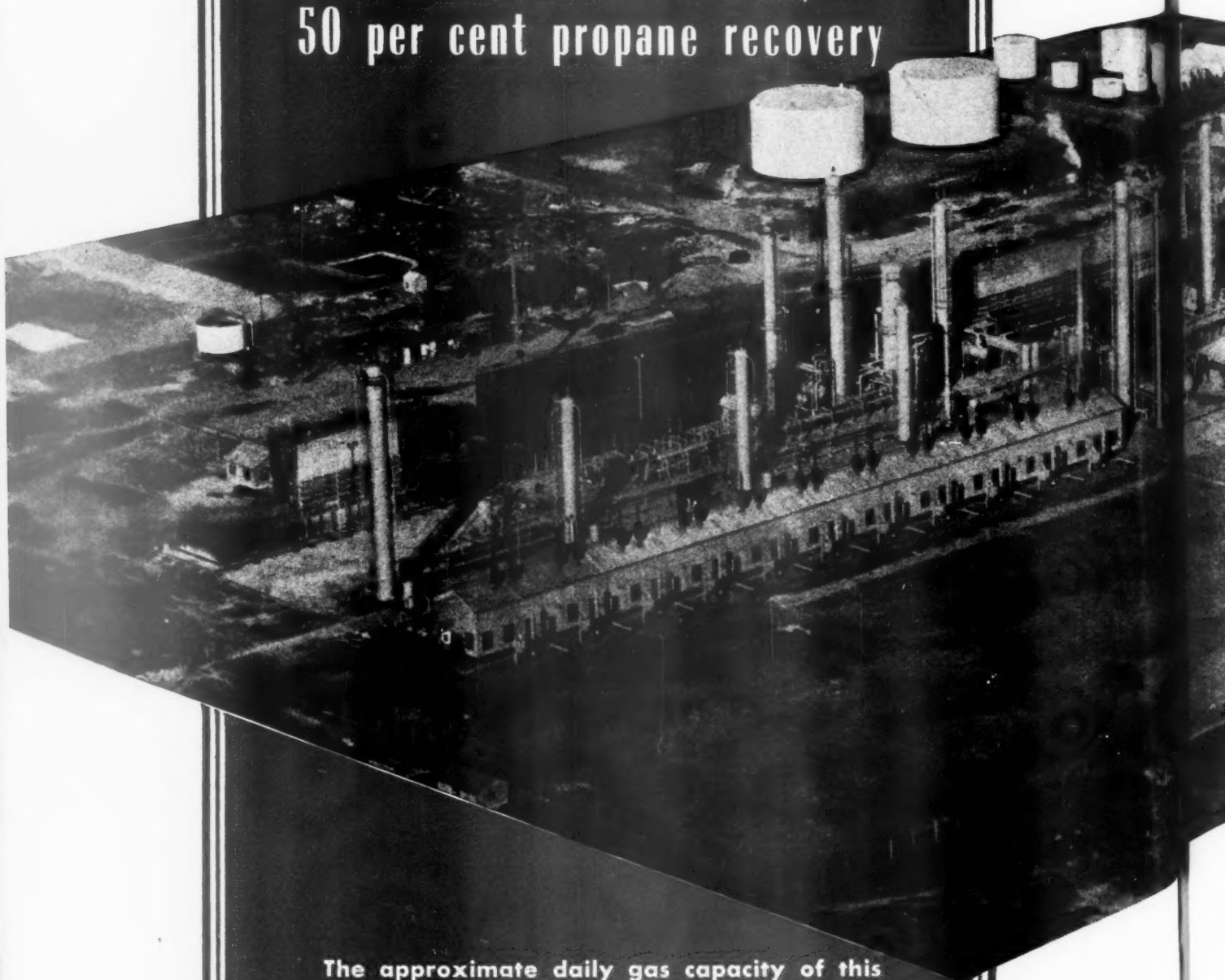
An accompanying illustration shows a battery of compressors that lift pressure in two stages to a point where injection can be made into gas cap wells. Gas for the supply of the Calgary-Lethbridge system is taken from the intermediate pressure level and passes through scrubbers for removal of hydrogen sulphide and carbon dioxide before entering the mains to the city system.

● **Natural gas hearing.** When repressuring of gas began in Turner Valley, the question arose of who should pay for the cost of compressing the gas, and for the

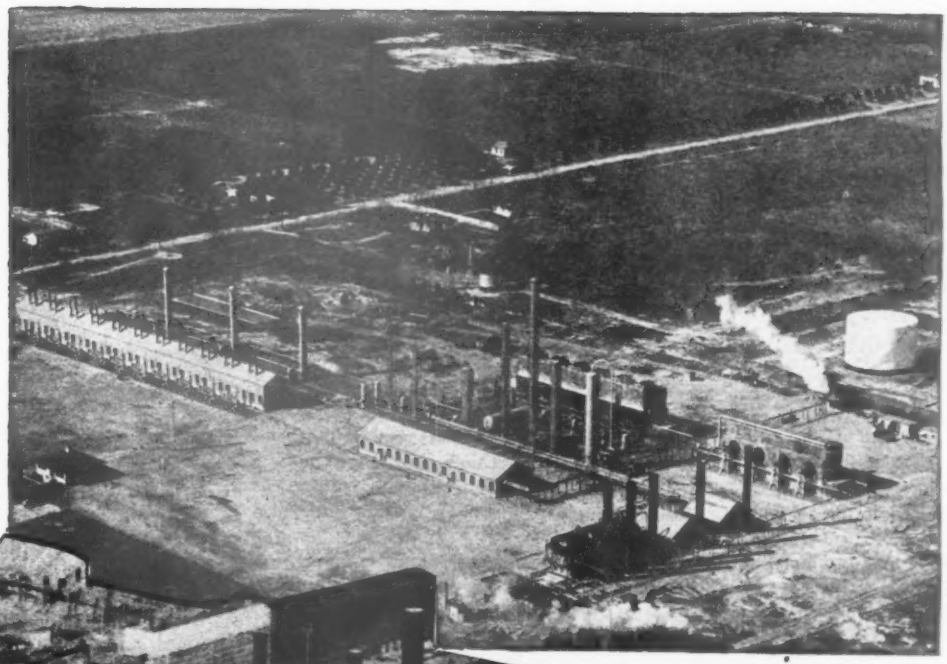
*Floyd K. Beach, engineer for the Petroleum and Natural Gas Conservation Board, Calgary, Canada, has covered Canada in the foreign issue of *The Petroleum Engineer* for many years.

THE NEW *La Gloria*

300 million cubic feet daily...
50 per cent propane recovery



The approximate daily gas capacity of this plant was increased from 150 million to 300 million cubic feet in successive plant expansions, the original plant and all of the additions being designed and installed by HUDSON. In each expansion, revised process design was employed to allow maximum use of previously installed equipment, thus minimizing the expense of the additions.



A view of the original plant finished in 1941.

An aerial view of the plant as it appears today after four major expansions.

THE HUDSON organization, qualified by years of experience in the successful design, construction and operation of major hydrocarbon processing plants, offers its specialized services for projects in any part of the world.

GAS COMPRESSOR STATIONS • CYCLING PLANTS • GAS DEHYDRATION PLANTS • NATURAL GASOLINE PLANTS • FRACTIONATION UNITS • CRUDE TOPPING UNITS • PRESSURE MAINTENANCE PLANTS HYDROGEN SULPHIDE REMOVAL PLANTS • ATMOSPHERIC AND VACUUM DISTILLATION UNITS

HUDSON ENGINEERING CORPORATION

Engineers and Constructors

FAIRVIEW STATION • HOUSTON, TEXAS

TABLE I. Canadian consumption petroleum fuels, thousands of bbl.

	1940	1941	1942	1943	1944	1945
Aviation gasoline	351	1,592	3,342	4,586	4,096	1,563
Other gasoline	24,857	26,269	23,439	22,622	24,438	27,958
Tractor distillate	723	1,063	1,200	1,170	1,145	1,117
Kerosine	899	959	1,049	1,097	1,121	1,310
Light fuel oil	5,718	6,947	6,964	7,160	7,266	8,509
Heavy fuel oil	14,571	16,521	15,892	14,961	16,666	16,938
Total	47,119	53,351	51,886	51,596	54,732	57,395

gas being repressured. Other related questions arose, and a hearing was held before the Natural Gas Utilities Board. This board was originally composed of G. M. Blackstock, who also headed the Alberta Utilities Commission, and Dr. E. H. Boomer, who headed the Petroleum and Natural Gas Conservation Board. Opportunity was given all interested parties to present evidence, and the hearing continued intermittently for many months. Dr. Boomer died suddenly on October 27, 1945, leaving Blackstock to make the decision alone. Up to the time of writing, the decision has not been promulgated, and in the meantime only temporary settlements have been made respecting gas deliveries to storage.

The death of Dr. Boomer, in the prime of life, and with many important connections, has been felt very widely. In addition to his connection with the two boards mentioned above, he headed the department of chemical engineering at the University of Alberta, and had acted as consultant on a number of wartime chemical developments. After V-E day he accompanied other scientists in visiting and investigating the synthetic oil industry of Germany, and the strain of that tour may have hastened his death.

● **New natural gas outlet.** Northwestern Utilities, Ltd., operator of the Viking and Kinsella gas fields, of a pipeline system from these fields to Edmonton, and of the Edmonton gas distribution system, has a new pipe line under construction that will extend to Red Deer. The line has already been connected up to two of the towns en route and is delivering gas to consumers. It is expected that the line may have reached Red Deer by the time this is published.

● **Crude oil prices—Turner Valley.** Effective January 1, 1946, Turner Valley crude brought $2.11 for 40-deg. API (the average) with an increase of 2 cents for each degree above or a decrease of 2 cents for each degree below, up 45 cents from the previous posting. This price is at the producer's tanks and is subject to a pipe-line deduction in quantity of three-quarters of 1 per cent from the calculated volume at 60°F.

Natural gasoline has been stabilized to yield a maximum of isobutane since completion of an alkylate plant built by the Dominion Government on the grounds of the Imperial refinery in Calgary and put into operation early in 1943. In March, 1946, Imperial took over operation of the plant. Changes in the picture of aviation gasoline demand called for revision of the price structure, and the following schedule was issued:

26-lb. R.V.P. product, per bbl.	$2.88
Propane and normal butane (except that contained in 26-lb.)	0.40
Isobutane	0.80

The 26-lb. product is assumed to be 150 per cent of pentanes plus. Pentanes will be determined and to such volume will be added 50 per cent, reducing normal butane.

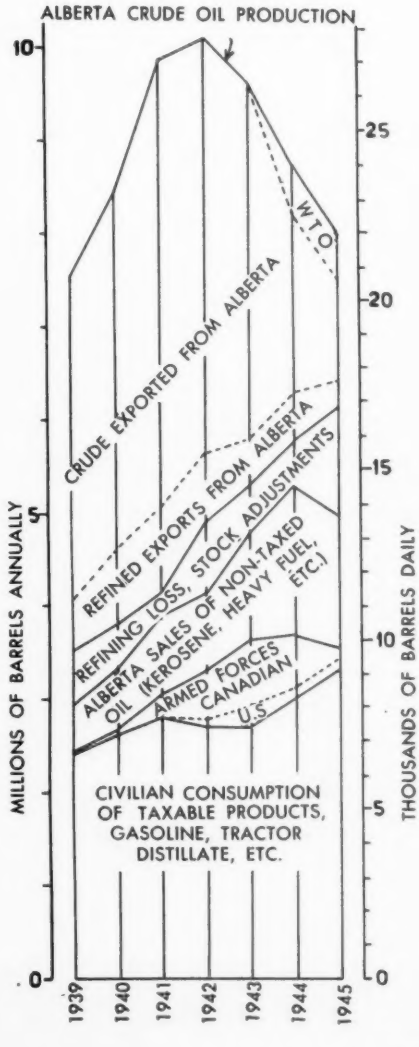
This was an increase of 60 cents on 26 lb., 12 cents for propane and normal butane, but a decrease of $2.34 on isobutane.

● **Conrad, Taber and Princess.** Most of the production in the Conrad, Taber, and Princess fields is from wells owned or operated by California Standard and sales are made to Standard Development Company, Ltd., who in turn ship to various purchasers. Recent average prices at the well appear to be:

Conrad	25 to 27 deg.	$1.16
West Taber	22 deg.	1.00
East Taber	17 to 18 deg.	0.94
Princess	33 to 35 deg.	1.95

Standard Development markets some of the oil to North Star Oil Limited, Winnipeg, and a larger proportion to Imperial Oil.

FIG. 1. Distribution of Alberta production.



● **Vermilion.** Canadian National Railway purchases most of the output of the Vermilion field for locomotive fuel, paying $1.34 f.o.b. railway tank cars at a treating plant where sediment and most of the water is removed. The plant pays producers on a sliding scale dependent on per cent B. S. & W., starting with $1.20 per net bbl. where B. S. & W. is less than 20 per cent. The vendor pays for hauling oil to the plant at 8 cents per gross bbl.

The largest producer, Cannar Oils, is a wholly owned subsidiary of Canadian National Railway and was started as a war venture to increase domestic railway fuel. Its drilling program ended early in 1944 and no other drilling is now going on in the proved oil area.

● **Lloydminster.** A treating plant similar to that at Vermilion has been handling the production from the Lloydminster field and the price has been about 10 cents lower than at Vermilion. Recent expansion of production on the Saskatchewan side did not immediately find a market and stocks began to pile up in open pits at the wells.

An asphalt plant is now promised for Lloydminster and Canadian National has accepted part of the production, so it is expected that all the potential production will be absorbed.

● **Alberta drilling activity.** *Foothills.* Prospecting has gone on both in the disturbed belt of the foothills and on the relatively flat structures on the plains, in extensions to earlier discoveries, in looking for new discoveries in horizons that have given anything from showings to production in other areas, and in looking for deeper horizons. The small independent having no producing wells is almost extinct, and a number of United States major companies are in the field.

Jumpingpound is still in the prospecting stage. Shell controls the entire structure. That company's well drilled in 1944 found gas and condensate in the top of the structure at 9618 ft. depth to the top of the Rundle lime. Its 1945 well, three-fourths mile to the southwest (down structure) found salt water in the Rundle, topped at 10,639 ft., giving structure relief of about 1000 ft. The 1946 well, midway between, found the Rundle about 300 ft. higher, but the collapse of drill pipe during a test entailed a long fishing job. On sidetracking some 200 ft. of drill pipe the limestone was again reached and casing set. The well drilled to the dark lime (usual base of the productive horizon in Turner Valley) and finished drilling September 25 at 10,579 ft., 250 feet in the Rundle. Tests are now proceeding and it is known that there is gas at the top and salt water at the bot-

YOU'LL PUMP ANY WELL FOR LESS MONEY WITH AXELSON EQUIPMENT

All Jones & Laughlin Supply stores are Axelson minded because any well can be pumped more satisfactorily with Axelson Sucker Rods and the right Axelson Bottom Hole Pump.

Moreover, we don't stop with meeting your initial requirements. We stock Axelson pump parts everywhere, and we maintain Axelson pump repair shops at conveniently located stores.

Our faith in Axelson pumping equipment has been justified by customer experience in every field from the Rocky Mountains east. Axelson has the facilities, and has demonstrated the initiative and ability, to build pumps that master every bottom-hole problem known to the oil industry.

If you have a troublesome well, or one that fails to produce like you know it should, talk with the men in your Jones & Laughlin Supply store. See what Axelson has to offer.

Export Sales Office: 230 Park Avenue, New York 17, N. Y.

JONES & LAUGHLIN SUPPLY COMPANY

Subsidiary of Jones & Laughlin Steel Corporation

TULSA, OKLAHOMA

J&L STEEL

FIG. 2. Scene of oil activity in Alberta.

tom of the limestone section drilled. Prospects are not too bright for oil production.

In the Brazeau area, Home Brazeau Syndicate at a total depth of 11,689 ft. penetrated two slivers of Rundle and tests of the upper sliver yielded gas, condensate, and water. The water had a low concentration, suggesting merely condensation of water vapor, and there is a feeling that the condensate oil is indicative of a liquid phase farther down the structure.

Imperial, Shell, Socony-Vacuum, California Standard, Home, and Anglo Canadian joined in the test and a Shell rig did the drilling.

Imperial Shell Stolberg, some 11 miles south and 20 miles east of Home Brazeau, drilled to 13,747 ft., a record depth for Alberta, exceeding by some 800 ft. the previous record of 12,955 ft. made in Imperial Coalspur last year. The Stolberg well has been plugged back for about 100 ft. for a test of the Rundle. As in Home Brazeau, there was an upper sliver of Rundle and drilling was carried far enough in the second Rundle occurrence to make sure it was not merely a faulted sliver; the drill went into Banff shale that underlies the Rundle. Water was found in the lower occurrence of the Rundle and tests are to be made of the upper sliver.

Ram River company has continued diamond drill operations and has had two rigs working.

"Operation Muskeg" is a joint venture by Imperial, Shell, Gulf, Socony-Vacuum, and McColl Frontenac (Canadian subsidiary of The Texas Company). It involves construction of about 70 miles of all-weather road from Entrance to the northwest before drilling can begin at a location that has been selected on the basis of surface geology and a seismic profile made to check conditions at depth. The location is in country uninhabited, uncultivated by agriculture, and untouched by the drill.

An independent venture, Roxana 3K, in 7 of 31, 27-6 W.5., is an interesting location at the easterly side of the disturbed belt. It is drilling with cable tools below 5000 ft. and has had some gas flows.

Phillips Petroleum Company drilled a second dry hole in the Sullivan Creek area.

Several other independent operations in the foothills area are in progress. The long continued Maxmont cable-tool hole near Lundbreck has had numerous oil showings but at 9912 ft. seems about bogged down by fishing operations and shortage of materials. The same operators have started another well about three and a half miles south and a mile west, and another independent has begun drilling in the next township to the west and somewhat to the north. Both these latter operations are starting with cable tools and progress is slow.

From Turner Valley, several wells are working eastward with some success in the "eastside lime," where the producing Rundle lime is 1000 or 1100 ft. deeper than in the upfaulted main body. Some success has also been met in tracing another fault block to the west of the north end of the field, but two wildcats hoping to find a northward extension were abandoned early this year when the producing zone was found at a depth where only salt water was present.

Syncline. Royalite DeWinton, some 12 miles east of the north end of Turner Valley, found water in the Rundle and a nice showing of oil in the Brown sand of Fernie (Jurassic) age above the Rundle. Careful tests of the Brown sand occurrence failed to develop production and the well was abandoned. This test is in the Alberta geosyncline and it was hoped to find oil accumulation in a local high.

Imperial Anglo Crossfield, some 18 miles north of Calgary and a little west, found a thick sand in the basal Blairmore with oil showings, and there was encouragement for further exploration in this part of the geosyncline, although the showings in this well did not prove of commercial proportions.

Plains. California Standard, one of the most active wildcatters for several years in the plains area, has largely devoted

TABLE 2. Canadian crude oil production, barrels. (From Dominion Bureau of Statistics and Alberta Petroleum and Natural Gas Conservation Board.)

	1945 12 months	1945 first half	1946 first half
Turner Valley	7,422,061	3,859,940	3,308,21
Jumpingpound	3,471	1,977	1,477
Vermilion	238,358	127,275	90,738
Lloydminster	28,321	11,937	24,965
Wainwright	16,472	7,375	6,078
Taber	135,000	74,400	101,302
Conrad	143,696	36,378	112,606
Princess	63,377	22,152	33,406
Other fields	4,684	3,902	1,554
Alberta total	8,055,440	4,145,336	3,680,339
Saskatchewan	16,509	0	42,418
Northwest Territories	353,137	309,799	74,128
Ontario	113,084	53,273	59,470
New Brunswick	31,027	13,403	14,050
Canada total	8,569,197	4,521,811	3,870,405

TABLE 3. Footage drilled in Alberta for oil and gas, thousands of ft.

1945	Oilfield development	Gas development	Wildcat	Total
First quarter	55	1	33	89
Second quarter	80	3	70	153
Third quarter	105	3	62	170
Fourth quarter	45	6	81	132
Year	285	13	246	544
1946				
First quarter	47	9	30	86
Second quarter	39	26	40	105

Oilfield development in 1946 was down as Turner Valley drilling slackened to 3 to 5 rigs.

Gas development was most active in Viking-Kinsella area with spacing generally so great as to put most wells in a doubtful position when located. Two wells listed as wildcat and involving 4000 ft. might have been included under the heading.

Completions, first half of 1946

Oil development:
- Turner Valley, 6—2 water (distant extensions).
- Taber, 1.
- Conrad, 1.
- Princess, 1 water.
- Lloydminster, 4.
- Total, 11—5 dry.

Gas development, wildcat:
- 1, oil.
- 3, oil and gas showings.
- 1, gas and salt.
- 21, dry (17 drilling, end of June.)

itself this year to exploitation of its discoveries, but has joined with some other operators in a few wildcats, and has drilled several wells on its own.

A wildcat (Baxter Lake) drilled by independent interests several miles northeast of the old producing Wainwright field made a nice oil discovery, but just how good it is will not be fully known until it begins marketing. There appears to be some water with the oil.

Imperial's Provost discovery of oil in a sand at the top of the Lower Cretaceous came in June and to the end of July it produced 805 bbl. during about 40 days operation, or an average of about 20 bbl. a day. The performance stimulated the drilling of a well just across the Saskatchewan border, about 22 miles to the southeast, and independent interests have spotted a location about 12 miles southeast of the discovery. Imperial followed up the discovery with two wells, neither of which have confirmed a field and a rig is now being moved about five miles east for another test.

McColl Frontenac and Union have joined forces for a program of prospecting in an area just north of the Montana border in the eastern part of Alberta and have discovered a large gas flow in one well and perhaps as large a flow in a second well. Although prospecting for oil, they value the gas discoveries and are carefully testing them.

In the area surrounding the gas company's Viking-Kinsella field, Imperial has been engaged in gas exploration and has proved up gas in quite an area by wells spotted one or two to the township. Statements given to the press indicate that this exploration is related to studies being made into the feasibility of synthetic oil manufacture beginning with natural gas as material.

The northeastern part of the area that has been proved up by Imperial as a gas reservoir is about 20 miles west and a little south of the Vermilion oil field. Some 35 miles north and a little east of the Vermilion field, Anglo Canadian put down a test to a depth of 3929 ft., finding rock salt in three beds totaling 750 ft. This test, known as Elk Point 1, is in 7 of 26, 56-5 W.4. An earlier well 45 miles south and a little west found 415 ft. of salt, and an old well near Wainwright logged thick salt in about the same horizon. Now with salt reported from the Unity area in Saskatchewan, and even older discovery of salt at Simpson, some 200 miles east, it is apparent that supplies are widespread. In order to develop a chemical industry, adequate water supply and fuel are also needed, and transportation costs to markets need to provide possibility of successful competition with other sources. It is too early to say that all these factors are present, but it can be pointed out that the Elk Point salt discovery is close to the North Saskatchewan River, a large water supply, that there are abundant gas supplies within reasonable pipe line distance, and railways that could be extended to the locality at moderate cost. It is possible that gas may be developed at the site in adequate quantity.

Salt is being produced commercially at Waterways (railway terminal for McMurray) from a deposit 200 ft. thick, and it supplies western Canada, but coal has to be shipped in by rail, and the salt comes out by the same route. Hence expansion of a large chemical industry would be less favorable at Waterways.

● **Other Alberta prospecting.** Aside from actual drilling operations, a number of companies have been carrying out geological and geophysical studies of the vast undeveloped oil country in Alberta and contiguous areas.

Sun Oil Company has been seismographing a big area for the last two years. It lies from Calgary to Princess and from Red Deer River to somewhat south of Bow River. The company has now made a location in 11 of 8, 18-16 W.4. This is about two miles east and about the same distance south from California Standard's Eyremore well drilled in 1942.

Gulf has continued geophysical work (gravimeter and seismograph) in the foothills area and is a partner in Operation Muskeg.

Socony-Vacuum continues to operate geological parties in the far north (Northwest Territories) and in British Columbia east of the Rockies, and has shared in Home Brazeau and Operation Muskeg.

Shell has carried on gravimetric work in the plains and seismic work in the foothills.

Phillips Petroleum has one or two field geological parties along the Alberta-British Columbia boundary near Peace River.

Rio Bravo, Canadian subsidiary of Superior of California, and Pure Oil each maintain a geological staff in Calgary, and several other United States majors have made occasional visits to keep abreast of developments.

● **Bituminous sands.** The Dominion Government recently announced negotiations for the return of Abasand properties to the company. The Dominion, as a war measure, spent more than $1,500,000 in an effort to develop commercial methods of extracting oil from the sands. The commercial returns so far have been negligible and operations have been dormant for some time.

The Province of Alberta has been backing the construction of a plant at Bitumount, 50 or 60 miles north of McMurray, but no recent reports on its progress have been issued.

Battery of compressors to boost pressure in Turner Valley.

Both photos by H. Pollard, courtesy Madison Natural Gas Company.

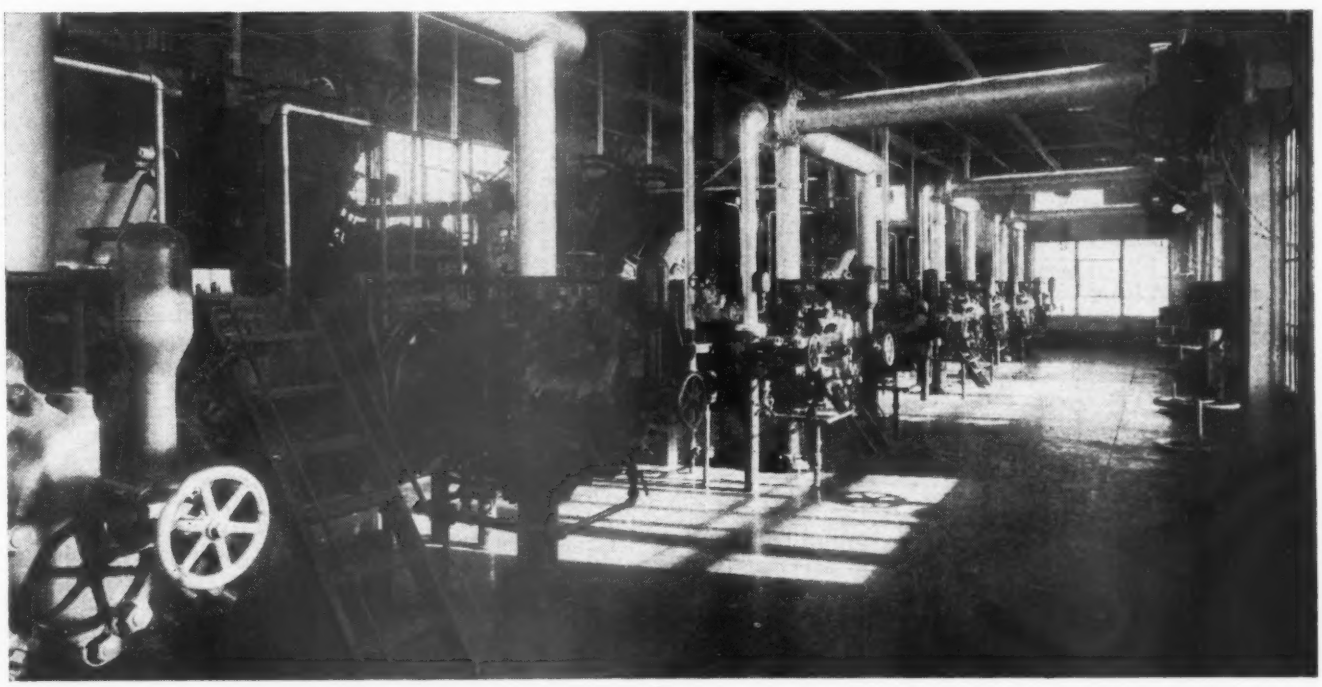


TABLE 4. Saskatchewan wells drilled in late 1945 and 1946.

Name	Location	Depth, ft.	Remarks
Cypress Fox Valley	16 of 26, 17-26 W. 3	3241	Some show of oil and gas.
Millar Pale	11 of 36, 36-17 W. 3	....	Tests of old well negative.
Community Services—Watrous	4 of 2, 32-25 W. 3	3868	Suspended.
Bata 13	10 of 3, 39-22 W. 3	2174	Abandoned.
Bata 14	14 of 28, 38-22 W. 3	2273	Abandoned.
Bata 15	13 of 13, 41-24 W. 3	2081	Plugged to 1630 ft. Small gas well.
Bata 16	11 of 24, 42-24 W. 3	1613	Small gas well.
Verbata 1	15 of 23, 39-23 W. 3	2078	Good gas well.
Verbata 2	7 of 24, 41-24 W. 3	4490	Salt, small gas.
Bata Provost 1	4 of 5, 35-38 W. 3	3161	Abandoned.
Oil and Gas Development 3	2 of 28, 47-27 W. 3	1775	Suspended.
Community Services 6	8 of 10, 49-28 W. 3	1883	Oil producer.
Community Services 7	3 of 4, 50-27 W. 3	2165	Suspended.
Community Services 8	SW 4 of 11, 49-28 W. 3	1868	Oil producer.
Community Services 9	NW 4 of 11, 49-28 W. 3	1872	Oil producer.
Community Services 10	SE 4 of 11, 49-28 W. 3	1873	Oil producer.
Community Services 11	SW 3 of 11, 49-28 W. 3	1865	Standing.
Community Services 12	NW 3 of 11, 49-28 W. 3	1875	Oil producer.
Community Services 13	NE 4 of 11, 49-28 W. 3	1865	Standing.
Community Services 14	SE 3 of 11, 49-28 W. 3	1869	Oil.
Community Services 15	SW 2 of 11, 49-28 W. 3	1880	Oil.
Community Services 16	SE 2 of 11, 49-28 W. 3	1878	Oil.
Community Services 17	NE 3 of 11, 49-28 W. 3	1871	Oil.
Community Services 18	NW 2, of 11, 49-28 W. 3	1864	Set casing, waiting.
Community Services 19	NE 2 of 11, 49-28 W. 3	1874	Set casing, waiting.
Grant Syndicate Groat 1	NW 5 of 1, 49-28 W. 3	1865	Oil producer.
Withers Groat 2	SW 5 of 11, 49-28 W. 3	1860	Oil producer.
Withers Groat 3	SE 5 of 11, 49-28 W. 3	1861	Oil producer.
Lloyd. Gas Company 5	9 of 26, 49-28 W. 3	2001	Abandoned.
Lloyd. Gas Company 6	SE 13 of 24, 49-28 W. 3	1860	Oil discovery, 20 bbl. per hr. reported.
Van Lloyd. Erndell 1	NW 15 of 2, 49-28 W. 3	1882	Oil producer.
Van Lloyd. Erndell 2	NW 10 of 2, 49-28 W. 3	1880	Oil producer.

● **Saskatchewan.** Saskatchewan came into the picture as an oil-producing province in 1945 with several wells near Lloydminster, a town straddling the Alberta boundary. An energetic drilling program this year has enabled the field to produce 50,000 bbl. in the first seven months of 1946. Some oil has been accumulating in storage, as the low gravity, 14 deg. API, does not make it suitable for gasoline manufacture; however, a plant for making asphalt from the oil is now being erected and there is hope that all the oil that can be produced will soon find an outlet in this plant and as railway fuel.

The relatively low density of population in the prairie provinces and the high cost of asphalt have been deterrents to a comprehensive road-paving program, and it is hoped that a supply of asphalt close at hand may enable the program of paving to be stepped up.

In the Vera-Unity area five holes have been drilled this year by Bata Petroleums and Verbata. No great success can be recorded in extending the gas field discovered last year although three of the wells obtained small production. One of the wells found 435 ft. of salt, however, and as in some other occurrences, the upper salt beds carry some carnallite (potassium-magnesium chloride).

Following an oil discovery near Provost, Alberta, some 14 miles from the Saskatchewan border, Bata drilled a wildcat about 16 miles south and about a mile inside Saskatchewan. The oil discovery in Alberta was at the top of the Lower Cretaceous, but the Bata well found only salt water in this horizon. On drilling deeper, an oil showing was found in the Banff sand, a member low in the Madison. The showing yielded about 10 bbl. on a drillstem test but was low in gravity (about 10 deg. API) and was accompanied by water. The hole was plugged back but the showing is likely to encourage further tests in the vicinity. Farther north the Madison has been completely eroded, and the downward succession usually goes from Lower Cretaceous to Devonian, so it appears that there is a local condition favorable to oil accumulation.

Saskatchewan wells drilled in 1946 and late 1945 are listed in Table 4.

● **Kamsack.** In the Kamsack area several wells of less than 800 ft. deep were drilled for shallow gas wells at low pressure. Tps. 29 & 30, R 31 & 32 W.1.

● **Unity.** A transmission line and distribution system began delivering natural gas to the town of Unity in November, 1945. Negotiations for an additional outlet for the Unity field developed by Bata Petroleum, Ltd., are still being carried on. The Bata company now has engaged Brown Geophysical Company of Houston, Texas, to make a gravity survey prior to decision on further drilling.

● **Ontario.** After about 85 years of oil production from fairly shallow zones (300 to 500 ft. deep) in the "Big" lime (Norfolk or Delaware) of Devonian age, from fields in the southwest peninsula of Ontario, the past year has seen a concerted effort to discover oil or gas from lower zones, and some 30 tests have been put down.

The peninsula lies between the southern end of Lake Huron, Lake St. Clair, and Lake Erie and the recent tests are roughly within a triangle marked by Windsor, Sarnia, and Tilbury. Some of the tests have gone as deep as about 3800 ft., which reaches nearly to the base of the sedimentary column, with the most probable producing horizon the Trenton lime of Ordovician age. Imperial Oil drilled 12 tests in 1945 for a total footage of more than 14,000 ft. and expects about double that activity this year. Union Gas Company recently has been drilling even more actively than Imperial, and Dominion Gas Company also has done some prospecting. None of the tests has developed commercial oil or gas, but favorable showings have been sufficient to warrant further work.

Natural gas in this area is a money maker owing to dense population and lack of domestic coal supplies, all coal being imported. At one time this peninsula had large gas supplies and exported a large quantity of gas to Detroit, but the supply has been failing for some years and there are claims that some well operators have recently received as high as 30 cents per 1000 cu. ft. for gas at the wellhead, although that is probably unusually high. At present natural gas distribution is limited to the district marked approximately by Woodstock, London, Petrolia, and Sarnia. Manufactured gas in centers like Toronto is distributed for cooking and its cost is so high as to encourage exploitation of every natural gas occurrence. If used for house heating, manufactured gas will cost an ordinary sized house owner something over $400 for a winter's heat.

● **Nova Scotia.** S. C. Nickle, Calgary oil man, has a well drilling in Kennetcook County, about 40 miles north of Halifax. The well is currently reported about 1000 ft. deep, with objective the horizon producing gas and a little oil in the Stony Creek field of New Brunswick. Pre-drill estimates of depth were about 1500 ft. A gas discovery here would be of considerable economic value.

● **Quebec.** In Gaspé peninsula on the south side of the estuary where the St. Lawrence River widens to become a gulf, Palaeozoic sediments have beckoned the oil man for more than a century, and a number of tests have been put down, the earliest drilling being in 1860, and the deepest test so far reaching nearly to 6000 ft. During the past year operations have been carried on by Continental Petroleums Limited, and by Gaspé Oil Ventures Limited, both companies being headed by Paul Payette as managing director.

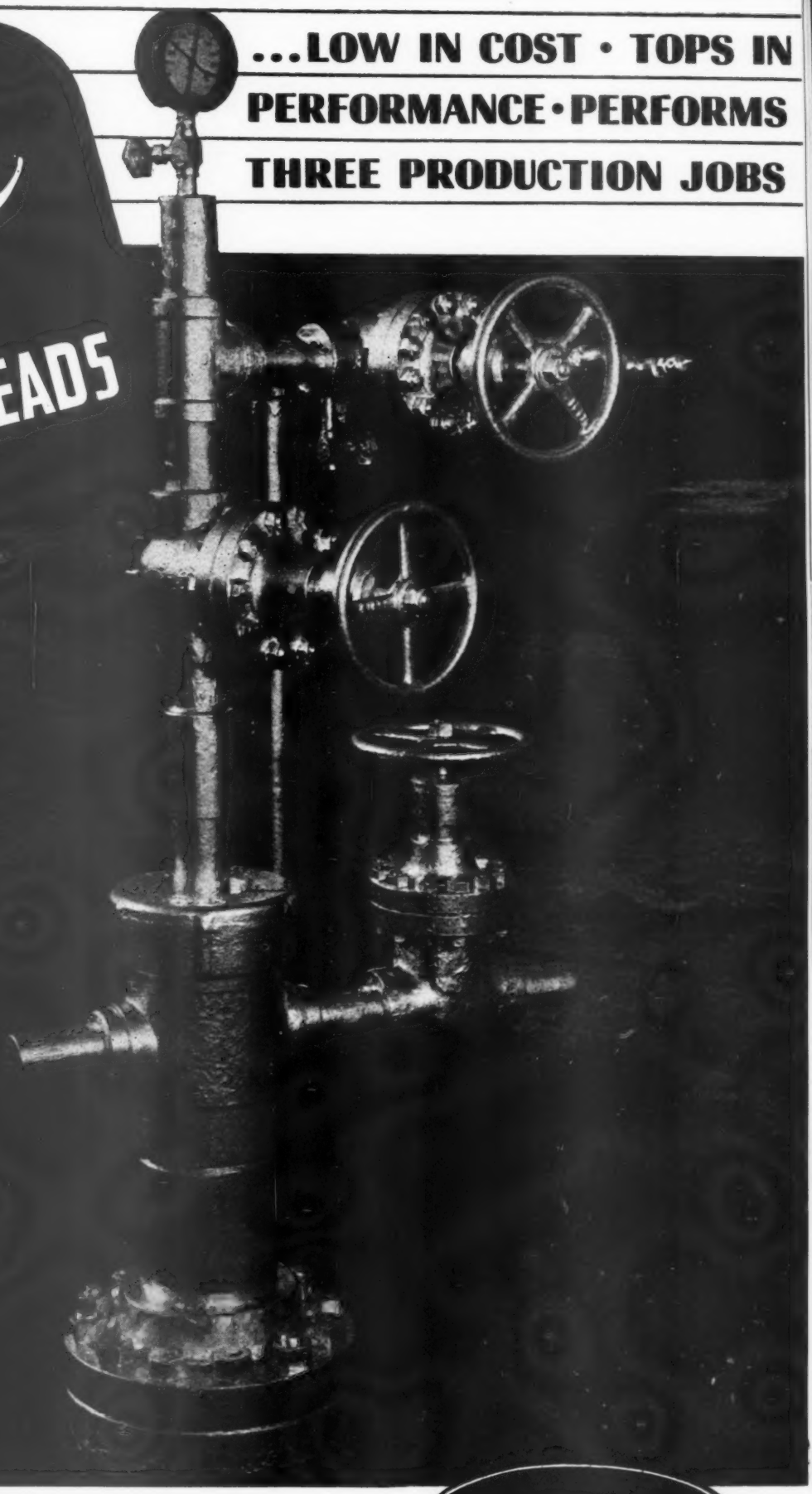
C.P.L. No. 2 was temporarily abandoned about a year ago at a depth of 2926 ft. It was situated in a surface-indicated syncline, but certain showings in other wells had led to its location. Continental Petroleums Limited No. 1 after some delays due to road-making in order to facilitate bringing in supplies, is now being deepened by Gaspé Oil Ventures and is below 2050 ft. Gaspé Oil Ventures No. 1 was spudded in early summer of 1946 and has reached a depth of 1330 ft., reporting Grande Greve lime at 1237 ft., much shallower than expected. Surface rocks are Devonian sandstones and objective horizons lie from 3000 to 8000 ft. deep.

In the Galt anticline, pre-drill estimates showed a probable 1700 to 2000 ft. of Devonian sandstone followed by Grande Greve limestone, 2300 ft. thick; Bon Ami, 1750 ft., and St. Albans (Silurian) 3000 ft. Both drilling wells are using cable tools, and there has been sufficient gas showing to encourage further development. H. A. Taylor is field superintendent.

★ ★ ★

...LOW IN COST • TOPS IN PERFORMANCE • PERFORMS THREE PRODUCTION JOBS

Larkin FORGED STEEL TUBING HEADS



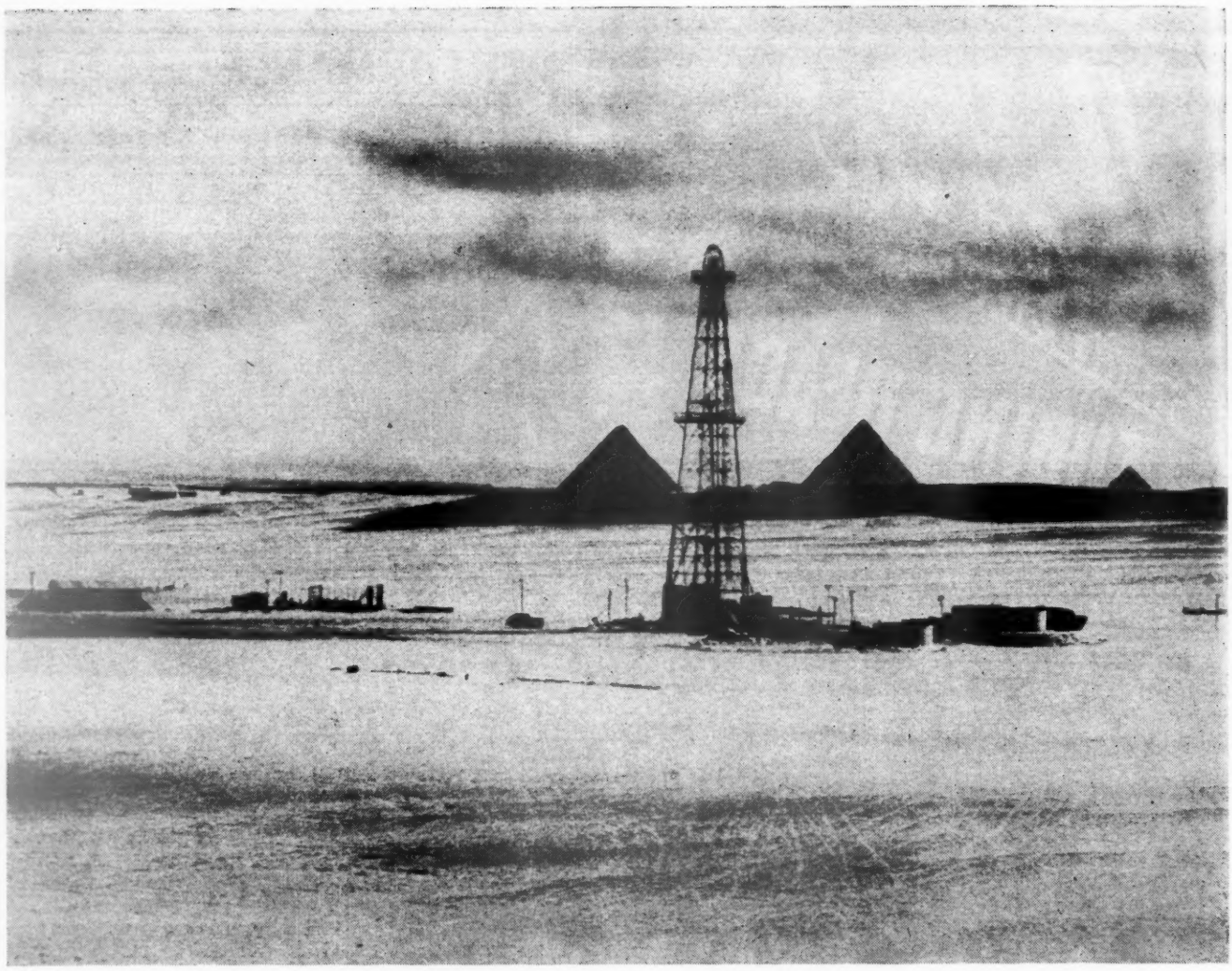
When this well stops flowing, the operator can keep right on producing through this Type "R" Larkin Tubing Head for the life of the well. It can be adapted to gas-lifting or pumping wells. It will serve dependably from completion to depletion. Low in initial cost and upkeep, Larkin Forged Steel Tubing Heads offer more for your money than any other low cost tubing head. And for that reason, more and more operators are turning daily to Larkin Tubing Heads. Its valuable combination of features can be found in no other head in the same price field. The all-forged steel Larkin Tubing Head shown here . . . 4000 lbs. test, 2000 lbs. working pressure . . . can be bought through your supply store.

LARKIN

LARKIN PACKER COMPANY, INC.

ST. LOUIS, MO.

Warehouses: Tulsa, Houston, Great Bend, Wichita Falls, Odessa, Shreveport, Corpus Christi.
West Coast: Howard Supply Company
Rocky Mountain: E. C. Dilgarde Company
Export: 19 Rector Street, New York 6



In the shadow of ancient Pyramids of Giza, near Cairo the Abu Roash well was begun in January by Standard Oil Company of Egypt. A true wildcat well, the costly operation is the only positive method to determine whether oil is beneath the desert. Encouraging evidence will provide incentive for other wildcats on the 6 million acres of land held by an exploration permit from Egypt.

Oil search at Pyramids

Sand and gravel impede travel over the desert route from the Pyramids to the well site. Trucks conveying machinery and equipment have frequent stops on the 4-mile journey between the concrete highway and the wildcat. The bit on the wildcat has passed the 5000-ft. mark and continues to go deeper in its search for petrolum.

Photos courtesy Standard Oil Company (New Jersey).

LANE-WELLS Gun Perforator

Gives you

BULLET SELECTIVITY

UNLIMITED PERFORATION DENSITY

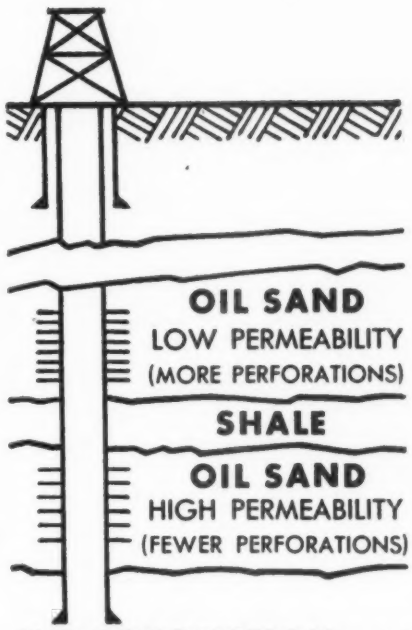
SELECTIVE PERFORATION

THE BEST BULLET FOR THE JOB

Lane-Wells Bullets are made in six standard types, in diameters to give you the perforation best suited to the requirements of the job. Steelflo design gives maximum penetration. Burrfree design eliminates inner burr when penetration is secondary. For best results discuss your job requirements with your nearest Lane-Wells Branch.

1 or 100 HOLES PER FOOT

Hole spacing to provide the best possible drainage means greater ultimate production at lower production costs. Whether it is a single hole per foot or a hundred Lane-Wells gives you unlimited flexibility of perforation density.



HIT PRODUCTION • • • SKIP BARREN FORMATION

Lane-Wells selective firing technique gives you target control. In many wells, zones in the same section vary greatly in permeability. You can perforate with any required density confining the shots to the productive streaks and skipping barren formations. Selective gun perforating places only the desired number of holes in each zone.

"Call Lane-Wells and have the job done right!"

LANE WELLS COMPANY

Los Angeles—Houston—Oklahoma City

General Offices, Export Offices and Plant:

5610 S. Soto St., Los Angeles 11, California

24-HOUR SERVICE 38 BRANCHES

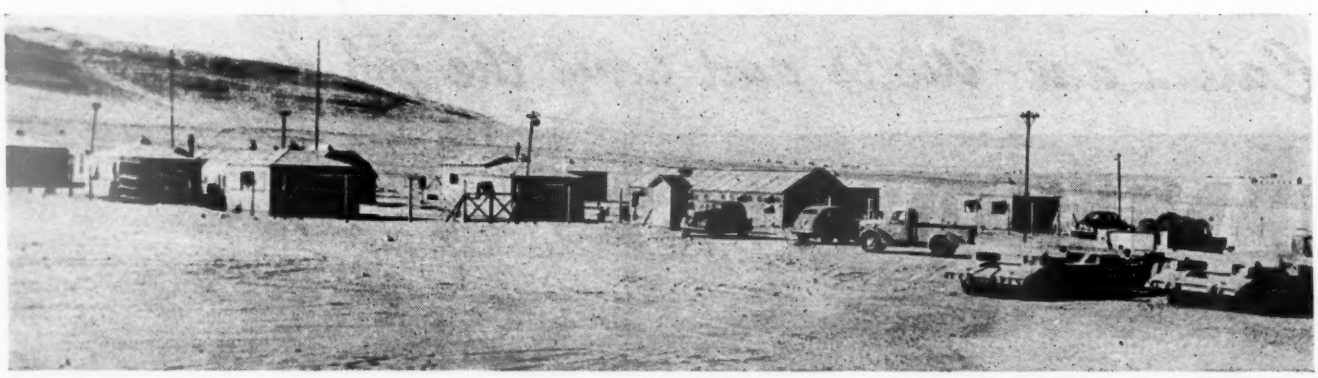
Call Us Today!

Native Egyptians man the drilling rigs in the wildcat operation and Egyptian and American geologists make microscopic examinations of fossils and particles of sedimentary rock as they are brought to the surface. Surface geology surveys of the Western Desert region of Egypt confirmed presence of nearby oil-bearing formation.

Rotary roller bit held by Egyptian drill-crew member has sharp gear-like teeth. Fluid mud jets out through apertures in the bit and returns to the surface through the casing outside the drill pipe carrying loosened debris. Water is brought by pipe line from the River Nile.

Staff camp houses dot the rolling expanse of the barren desert. Living quarters and workshops are adapted to climatic conditions, are equipped with electricity and other modern facilities.

THE END



How much is waste costing in YOUR plant?

Here's how you can reduce it with

BECKMAN pH CONTROL

IN industry after industry Beckman pH Control is reducing costs, minimizing waste, saving time and greatly increasing production efficiencies. Have *you* investigated what this amazing new profit tool can do in your plant? *Wherever there's water, there's pH.* So if you use water or water solutions of *any* kind . . . whether in pulps, liquids, or semi-solids—in process solutions, waste disposal or any other way . . . chances are that Beckman pH Control can help you do the job better—*for less.* Here, for example, is how others are slicing costs with Beckman equipment . . .

BECKMAN IS THE ONLY HIGH TEMPERATURE—HIGH pH EQUIPMENT

★ An important point to remember when installing pH control in your plant is that there is only ONE make of modern glass electrode pH equipment which can be used *continuously* in high temperature solutions. Even in boiling hot solutions, Beckman *High Temperature Glass Electrodes* give uniform accuracy and long life. This advancement is particularly useful in many food processes . . . in boiler feedwater conditioning . . . and in a wide range of chemical processing operations.

★ Beckman is also the *only* modern glass electrode equipment with which you can make high pH measurements *even in the presence of sodium ions* . . . a development that has extended the usefulness and accuracy of the glass electrode to many new industries where alkaline solutions, in combination with sodium ions, heretofore presented difficulties. A few of the many fields in which this Beckman development has proved indispensable include soap making, the manufacture of bleaches, detergents, etc.

SAVING CHEMICALS: By Beckman-controlling processes where chemicals are used, operations can be controlled so closely that overdosage and excess use of chemicals can be practically eliminated. Not only does this cut chemical costs, but it also assures more uniform processing, more accurate production control and greater plant efficiency.

REDUCING CORROSION: More and more plants are discovering the many advantages of reducing corrosion with Beckman pH Control. By Beckman controlling-process operations, these operators are able to regulate acidity and alkalinity—and thus neutralize excessively corrosive solutions before they damage costly plant equipment.

MINIMIZING REJECTS: Beckman pH Control is also making important savings by assuring more uniform quality of production. In many operations only a small change in pH makes a great difference in operation of the processing solutions. By Beckman-controlling the solutions, run after run is processed with identical quality, thus reducing rejects, cutting production costs and making greater savings in over-all efficiency.

SAVING TIME: Just as heat can frequently speed up chemical processes, so proper pH control can often save on processing time. Here again, even a relatively small saving on each production run quickly builds up to tremendous over-all savings in labor and plant overhead.

WHEREVER THERE'S WATER, THERE'S pH!

Let our engineering staff study *your* particular pH problem and make recommendations on the type of equipment best suited to your requirements. No obligation, of course.

For helpful information on pH control, send for this free booklet "What Every Executive Should Know About pH!"

BECKMAN INSTRUMENTS • NATIONAL TECHNICAL LABORATORIES
SOUTH PASADENA 26, CALIFORNIA

BECKMAN INSTRUMENTS CONTROL MODERN INDUSTRIES

European shale-treating practice*

By **ERNESTINE ADAMS**
Associate Editor

EXCLUSIVE

THE United States oil industry has spent little effort so far on the study of oil-shale mining, perhaps because of confidence in its ability to continue supplying sufficient petroleum for decades to come. Europe has not had the oil resources of the United States, however, and development of oil shale processes have made more headway, particularly in Germany, France, and Estonia. At the close of the war technologists were sent to Europe to visit plants engaged in processing shale for oil products.

Although European ventures in oil shale mining were generally subsidized by governments because of the vital need for petroleum products, the same methods might be worked into developments in the United States without subsidies on account of the better grade shale. The Congress has already appropriated a sum for the construction and operation of pilot plants in Colorado to pave the way for commercial units. It might be noted that most of the land with oil shale is at present in the hands of the federal government. Oil companies have apparently been indifferent to leases on oil shale properties.

● **Oil shales†.** Bituminous shales consist of rocks containing a certain proportion of organic matter known as Kerogen, which is transformed into a mineral oil by pyrolytic distillation. The oil does not exist as such but appears through the pyrolysis of the organic matter originally present.

Impregnated limestone is different from these shales in that its organic compounds distill without decomposition and are soluble in solvents, which indicate that they existed as such in the rock.

Upon heating in enclosed vessels, shales yield combustible gases that carry a certain amount of light benzine and crude oil, leaving minerals and fixed carbon in the oven. The distillation temperature is about 450°C. Distillation is more rapid and yields of oil are larger if pyrolysis of shale is carried out in the presence of steam.

Shale oil differs from petroleum in that it contains a larger proportion of unsaturated hydrocarbons. Shale processing is complicated by the presence of an enormous amount of worthless mineral matter, which has to be heated without any gain. The existence of this worthless mass determines the general characteristics that are common to shale ovens. Thus the most important problem is to reduce the cost of handling the bulky shale. Shale ovens must be run continuously and the throughput must be very large to operate a plant economically.

Suitable thermal balance must generally prevail for any given retort for economic reasons. The first step is to recover noncondensable gases and use them to heat the ovens if there are enough for this purpose but often this source is insufficient. Then the fixed carbon is used to supply additional heat. In some instances the fixed carbon alone is used for pyrolysis and noncondensable gases can be utilized in other ways.

● **Retorts.** There are three main classes of ovens used to heat the shale and abstract the oil products. These are: (1) retorts with internal heating, (2) retorts with mixed internal-external heating, and (3) retorts with external heating.

In the first type heat transfer may be carried out directly in the shale to be heated by fumes or hot gases coming from the combustion of the residual carbon or the distillation gases; or it may be carried out indirectly by recycling the distillation gases previously preheated by an exterior source of heat.

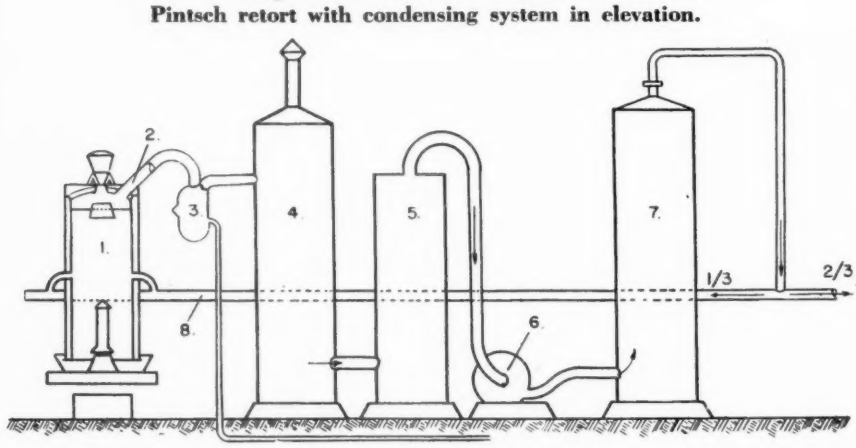
In the direct internally heated method there is considerable dilution of the vapors by distillation gases. One of this type, the Pintsch retort, Fig. 1, which is used in Estonia for the pyrolysis of rich shales, has the general appearance of a gas producer. Gasification of residual carbon in the lower interior zone supplies the upper layers with the heat necessary for processing crude shale.

In the indirect internally heated method, in which the recycle gases and combustion vapors follow separate cycles, only the recycled gases are condensed. It is possible, also, to condense only the excess of the gases being recycled. The volume to be condensed is thus reduced to a minimum and the use of small condensation plants is possible.

The best example of this system is the Lantz retort of the Grand Paroisse, Fig. 2, because of its high productive capacity and ease of operation. In this oven the capacity of 500 metric tons per day required an installation 7.2 ft. by 72.2 ft. by 55.7 ft. high. The oven is constructed entirely of metal and is very tight. Maintenance costs are low.

The Pumpherston retort, Fig. 3, is an example of both the mixed internal-external heating and the external heating. It is the oldest oven used in the oil shale industry, originating in Scotland and still operated there. It was used for years without internal heating, but this was eventually added by the introduction of steam and air into the shale being processed. The same retort is operated also in France and many improvements developed. Now most Pumphers-

FIG. 1. Diagrammatic vertical sectional view of the Pintsch retort with condensing system in elevation.



1. Pintsch gas generator (retort).
2. Gas and vapor offtake.
3. Heavy tar and dust separator.
4. Air condenser.
5. Scrubber condenser.
6. Gas exhauster.
7. Scrubber for light hydrocarbons.
8. Recycle gas.

*A review based on a report by William W. Odell, chief of the Synthesis Gas Production Division, Office of Synthetic Liquid Fuels, Bureau of Mines, and E. L. Baldeschwieler, technical consultant, Petroleum Administration for War, who visited European oil shale-treating plants. The full report is published in Information Circular 7348, Bureau of Mines, U. S. Department of the Interior, Washington, D. C.

†This discussion on shales and the classification of retorts are part of the report of a French research group, which wrote "Centre D'Etudes et de Recherches des Caburants et Lubrifiants de Remplacement," June, 1945. A translation is carried in the Odell and Baldeschwieler report.

ton retorts are mixed external-internal heating units.

These retorts are discussed in more detail later.

● **German processing.** It was not until Germany was already at war and was obstructed in obtaining oil supplies that the government encouraged shale-treating processing and ordered commercial plants at government expense. None of the resulting units were in operation long enough for thorough tests before the war ended and many were not even completed.

● **Portland Cement Works.** One plant that produced oil for more than a year was the Portland Cement Works at Dotternhausen. The unit had been in operation several years for the production of Portland cement from oil shale. In 1944 shale-treating retorts for producing oil were put into operation. Daily output of the plant when in operation was: Cement, 330 metric tons; hydraulic lime, 100 metric tons, and shale oil (maximum), 10 metric tons.

Eight Meier-Grolman retorts with actual capacity of 44 to 55 short tons per day per retort were installed to add oil to the products. Fig. 4 shows the flow of fluids in the operation of these retorts. In the first six months of 1944 a total of 42,850 short tons was put through the plant, yielding 3.47 per cent oil with the Fischer assay 68.4 per cent. Cost ran to an estimated $114 per short ton of oil.

In the Meier-Grolman retorts the oil shale was heat-treated in steam superheated to 800°C. in a recuperator system that passed horizontally through a downward moving mass of crushed shale. Oil vapors and gases passed out with the steam on the opposite side of the retort. Ground residue was marketed as hydraulic lime. The bulk of the residue was mixed with limestone and coke to produce cement.

Disposal of shale residue from retorting is one of the important problems in shale treating and the Portland Cement Works solved this patricular phase of processing shale.

● **Meiler units.** The Meiler process was another method well on its way to production when the war ended. It was installed as a pilot plant in 1943 and before experimental data of any importance were obtained the immediate construction of 10 commercial Meiler-type plants were ordered constructed in the Balingen district by the German Reich. Five of the units had operated three or four weeks when the war ended.

In this process shale is treated much the same as wood was processed in the past for the production of wood charcoal. The broken shale was piled in beds containing 1500 metric tons on top of a series of spaced pipes having slotted end sections. These pipes were connected to a gas-collecting main, which led to an exhauster. Each bed was 9.76 ft. deep, 42 ft. wide, and 130 ft. long.

A fire was kindled at the top of the pile and the products of combustion and pyrolysis were removed as generated by the exhauster and caused to flow through a cooling system, from which liquid products were removed. Approximately 2½ days were required for the heat wave to travel through the entire bed. The amount of oil recovered was said to be 80 per cent of that indicated by the Fischer test; oil content of the shale was 4.5 per cent by weight. Cost was equivalent to 36.4 cents per U. S. gal., allowing 40 cents for a mark.

The type of equipment required in this operation is not complex and the whole plant can be operated with a minimum number of highly skilled persons. Of the total oil produced 60 per cent was collected from the gas-heater drips and substantially all the rest from Cottrell precipitators. It is believed that there was an appreciable amount of corrosion in the pipe lines.

● **Underground plant.** An underground shale-treating plant was completed at Schorzingen, Germany, but was in operation only three months. The oil recovery was considerably less than was obtained by the laboratory Fischer test. In one test a field of two sets of seven chambers containing 13,060 and 13,550 short tons of shale produced 155 and 151 short tons of oil, respectively. Condensable oil vapors amounted to 15 per cent of the Fischer assay yield.

Treatment by this method is based on the Russian work on underground gasi-

FIG. 2. Diagrammatic sectional view of the Lantz retort of the Grande Paroisse, with gas circulating systems.

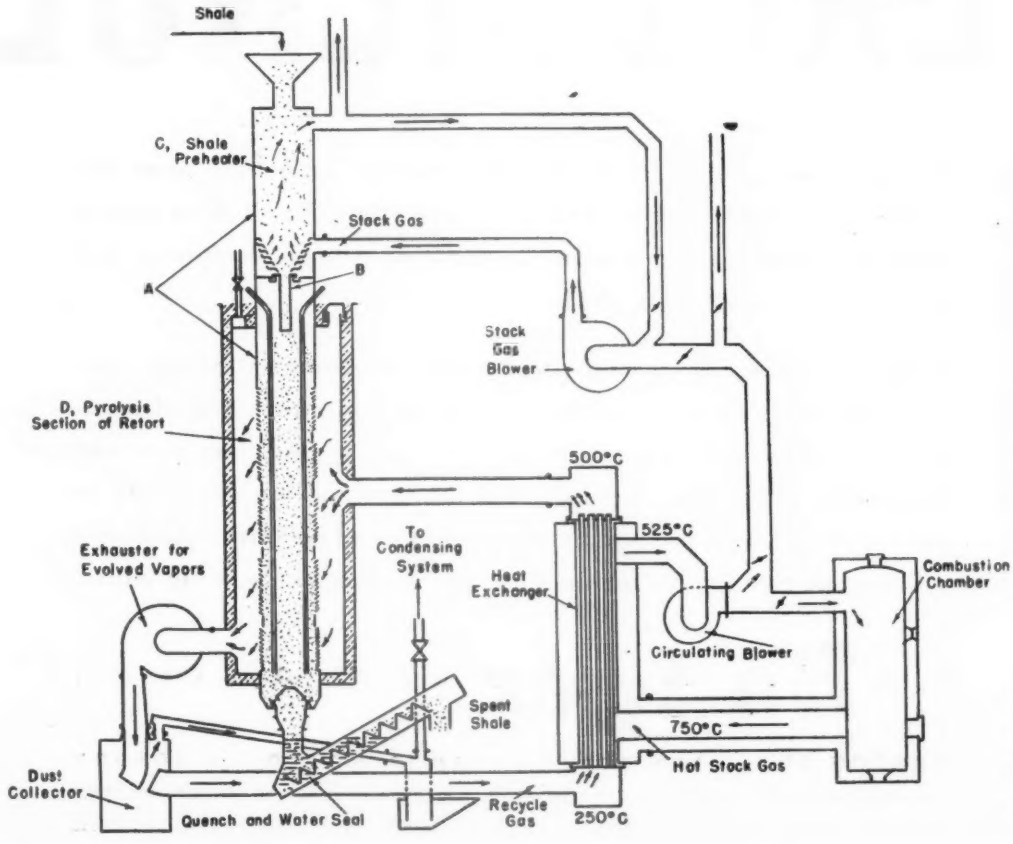
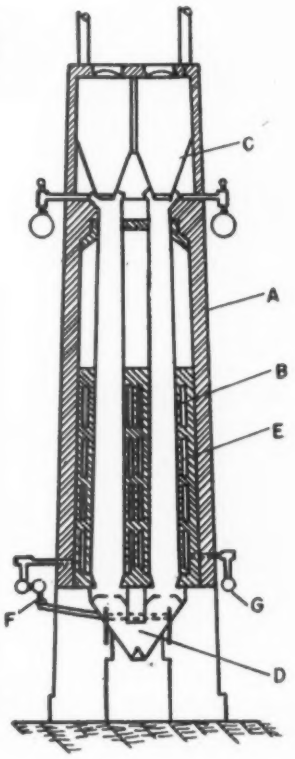
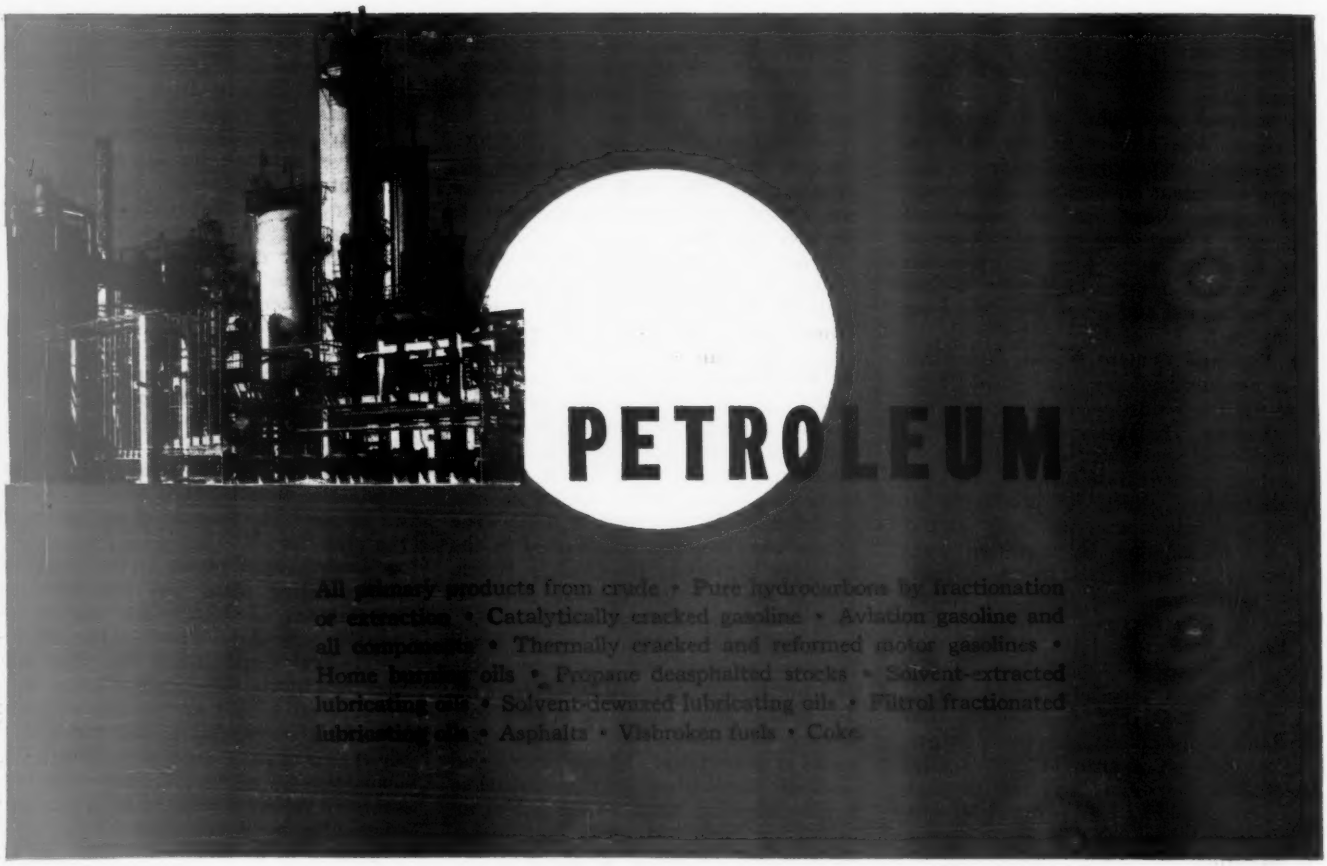


FIG. 3. Diagrammatic sectional view of a Pumpherston retort.



A—Cast iron retort.
B—Refractory brick retort.
C—Loading screen.
D—Unloading screen.
E—Gases produced in retort burned in these openings (external).
F—Steam and air injected here (internal).



EXPERIENCE

The petroleum, petro-chemical and chemical industries have become so interrelated that cumulative experience in all three carries definite advantage in process engineering and in designing and constructing new plants in any one of them.

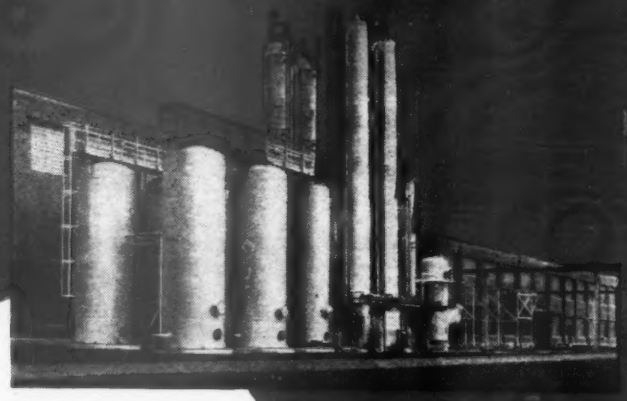
Badger is unique in the length, breadth and amount of such experience. It is evident from the accompanying partial list of products for which this organization, in its long career, has provided successful production facilities, that Badger has the versatility to execute the design, procurement and erection of any size petroleum-refining, petro-chemical or chemical plant—anywhere in the world.

E. B. Badger & SONS CO. • Est. 1841

BOSTON 14 • NEW YORK • SAN FRANCISCO • LONDON

PROCESS ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM, PETRO-CHEMICAL AND CHEMICAL INDUSTRIES

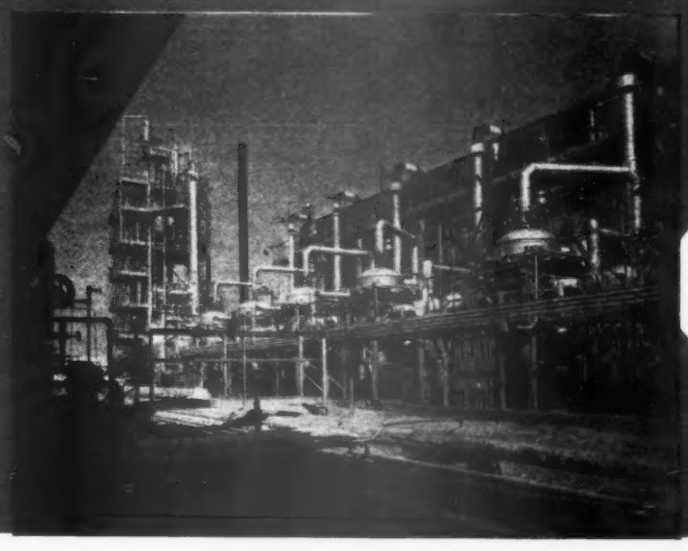
LICENSING AGENTS FOR THE TCC PROCESS AND THE HOUDRY CATALYTIC CRACKING PROCESSES



CHEMICAL

Industrial ethanol, isopropanol and higher alcohols • Methanol, synthetic and from wood distillation • Ethyl acetate, butyl acetate, dibutyl phthalate and other esters • Synthetic acetic acid and acetic anhydride • Nitrobenzene and other nitro-aromatics • Carbon tetrachloride, chloroform and other chlorinated hydrocarbons • Phenol, cresols, etc., from tar acids • Synthetic phenol • Aniline and other amino-aromatics • Beverage alcohol and spirits • Ethyl ether and isopropyl ether • Acetone and other ketones • Glycerine and glycols • Maleic and phthalic anhydride • Styrene • Ammonia • Fats and fatty acids • Ethyl benzene • Formaldehyde • Nitroparaffines • Synthetic camphor • Explosives and smokeless powder • Penicillin and streptomycin.

with all three



Butadiene • Styrene • Benzene • Toluene • Trinitrotoluene • Ethyl, isopropyl and other alcohols • Acetic anhydride • Formaldehyde • Maleic and phthalic anhydride • Nitroparaffines and their derivatives • Chlorinated hydrocarbons • Pure hydrocarbons.

PETRO-CHEMICAL

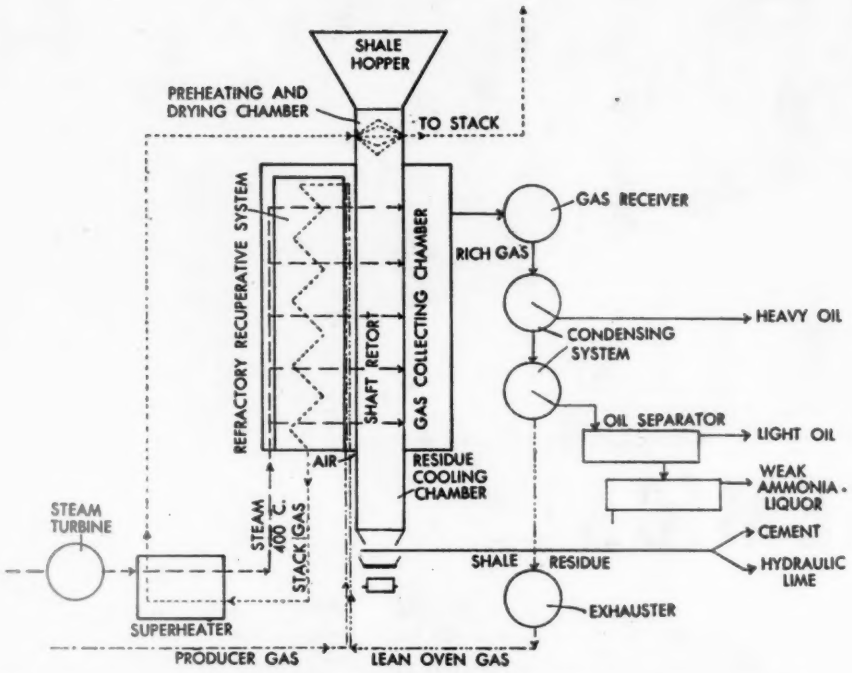


FIG. 4. Diagram showing flow of fluids in operation of Meier-Grolman retort.

fication of coal. The Schorzingen plant was forced into large scale operations by government pressure after some 16 different methods had been tried.

The plant operated by use of underground tunnels and internal combustion methods. The tunnels were 6.6 ft. wide, 7.2 ft. high, and 197 ft. long. The shale roofs and parts of the walls were broken by explosive charges until a group of tunnels were filled with a porous mass. Each of the tunnels were sealed at one end and a coke fire was started at the other end to ignite the shale within the tunnel. Suction was applied at the sealed end by an exhauster, the intake of which was connected by a pipe line to the sealed end of the tunnels. The evolved gases and vapors were removed through the latter pipe. Heavy oil condensed and drained from the unit.

● **Schweitzer ovens.** A plant was designed at Frommern, Germany, to use 28 Schweitzer retorts and construction was almost completed at the end of the war. The unit was rated to treat 1100 short tons of shale and produce 38.5 to 44 short tons of oil per day. The program for the future was to enlarge the plant to double that capacity in the expectation that this volume would make operation economical.

The operation is a batch process, the retort being lifted from its base and dumped after each batch is treated.

The crushed shale is charged into a cylindrical oven from the top to a depth of 16.5 ft. and then the shale is ignited at the top and the products of combustion and pyrolysis are withdrawn from the bottom by an exhauster. Steam is used to control temperature in the shale bed. See Fig. 5.

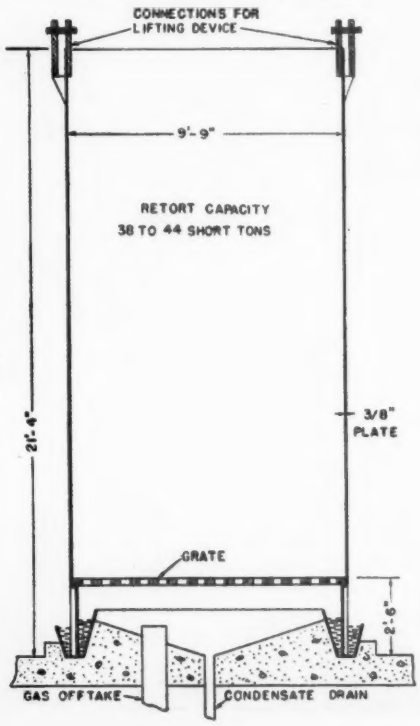
Based upon pilot plant experiments, anticipated results of the operation of the full size plant is said to be 85 to 90 per cent of the Fischer assay.

● **Autun plant in France.** Commercial developments have been insignificant in France compared to the long years of development and the need of a ready source of oil products. A plant at Autun is operating three batteries of Pumpherston-type retorts (See Fig. 3), 40 to a battery.

Broken shale, ½ in. to 4 in. size, is treated continuously by passing it downward through vertical retorts, which are externally heated by burning gases, internally by steam and air. Capacity of the Pumpherston retorts is 7 metric tons of shale per day each and oil yield is 85 per cent of the Fischer assay.

When the retorts at the Autun plant wear out plans are to replace them with Lantz retorts, which appear to offer more efficient operation.

FIG. 5. Diagrammatic sectional view of a Schweitzer retort.



● **Lantz retort.** Operated on a pilot scale at St. Hilaire, France, since 1938, the Lantz retort (Fig. 2), processes 88 to 100 short tons per day. One unit has now been built with an estimated capacity of 500 metric tons of shale per day.

Crushed shale, ½ in. to 2 in. size, is fed into the top of the retort and passes continuously downward, discharging at the bottom. The retort proper is rectangular in cross-section and has side wall louvres whereby hot circulating gases can be and are passed through the shale bed horizontally. The circulating gas is preheated to 500°C. in a separate furnace. Ten per cent of the gas is withdrawn for oil recovery. The upper portion of the retort, comprising a drying zone, is adapted to the passage of waste hot stack gases, which preheat the shale to be treated to 150°C. Water is used for quenching the spent shale as discharged and the steam generated passes into the gas-circulating system.

The shale remains in the retort four hours although all oil is said to be obtained in 30 minutes. The yield of oil is considered 100 per cent of that shown by the Fischer assay or 6.8 per cent by weight. This latter is approximately 17.7 U. S. gal. per short ton. In pilot plants the yield was 132 lb. of oil per short ton of shale treated.

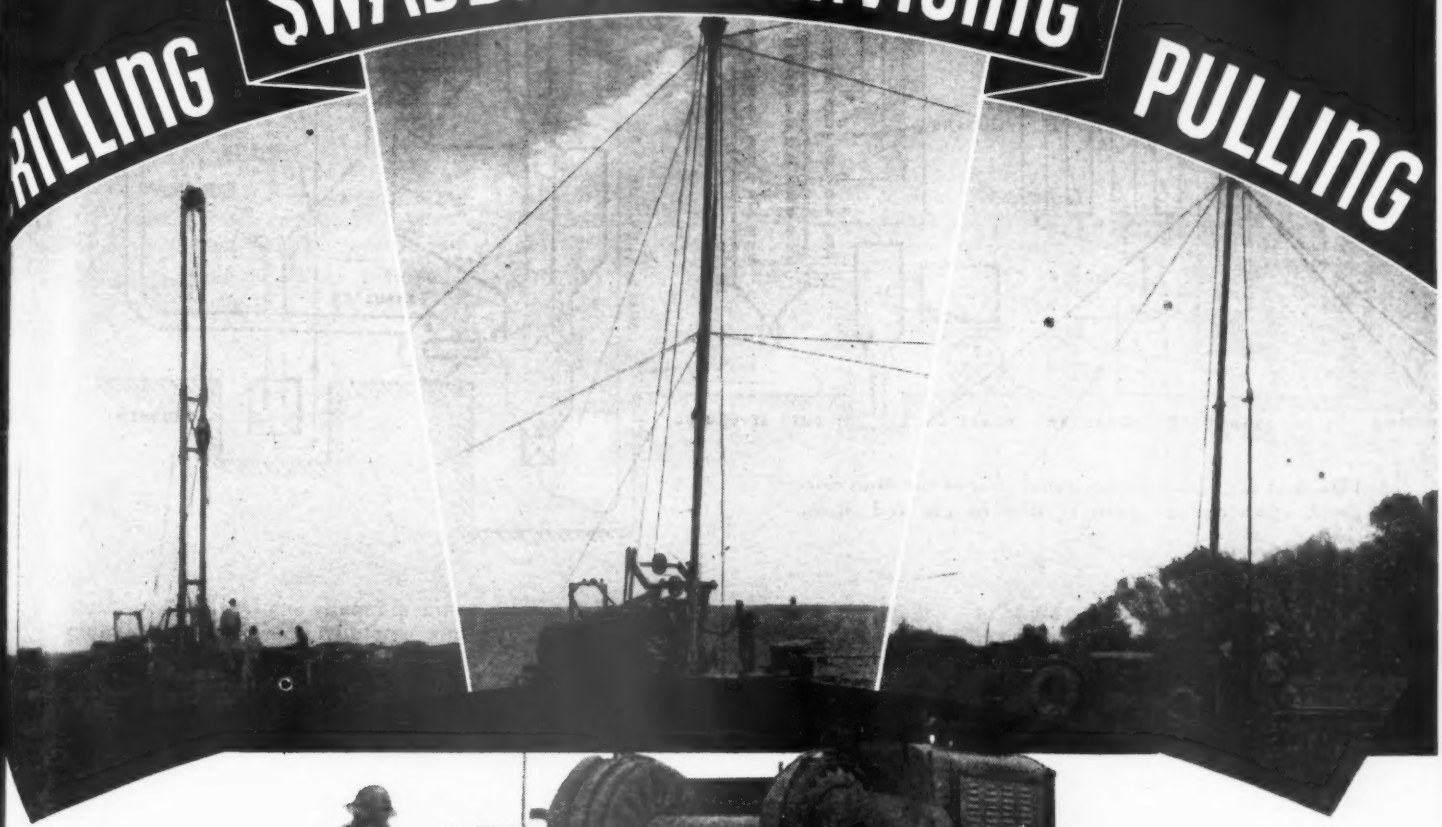
● **Marecaux retort.** In south-central France a new system has been developed with the Marecaux retort, (Fig. 6). It has been in operation on a pilot scale for over a year. The retort differs materially from others in that the inner cylinder rotates slowly and on its outer surface has cast iron helical members to agitate shale on its downward travel. A water seal prevents air from entering the retort.

Shale of ⅛ in. to 1 in. size passes downward between 2 vertical concentric cylinders as an annular column while heat is being applied externally to the outer cylinder. Superheated steam at 400°C. is introduced into the shale at numerous levels to facilitate pyrolysis. Yield of oil obtained in pilot scale operation was 92 per cent of the Fischer assay but there remained in the gas 8 per cent of condensable vapors, which would make the total yield of liquid products about 100 per cent of the Fischer test. This is about 85 lb. per short ton of shale.

● **Developments in Estonia.** Documents containing the plans for German development of oil shale treating, and recording the action that had been taken were acquired in Germany. In Estonia the higher quality shales are available and German technologists made an effort to increase production of oil products. Estonian bituminous shales yield by heat treatment as much as 20 per cent by weight of oil and readily condensable hydrocarbons. The Germans had as their objective an annual production of 1,500,000 metric tons of oil from this source.

WINCH TRACTORS

RILLING SWABBING - SERVICING PULLING



There's an Allis-Chalmers—Fred E. Cooper winch tractor for every well servicing job, regardless of field operating conditions, size of field, number, or depth of wells.

If you are interested in reducing well servicing and equipment maintenance costs, one of the 4 sizes of A-C Winch Tractors will produce the results you are seeking. Maximum line pulls are: Model L, 56,700 lbs.; Model E, 54,700 lbs.; Model M, 32,000 lbs.; Model W, 20,666 lbs.

All units are available with double drums, cleaning-out equipment, rotary drive and telescoping mast. All units are standard production models.

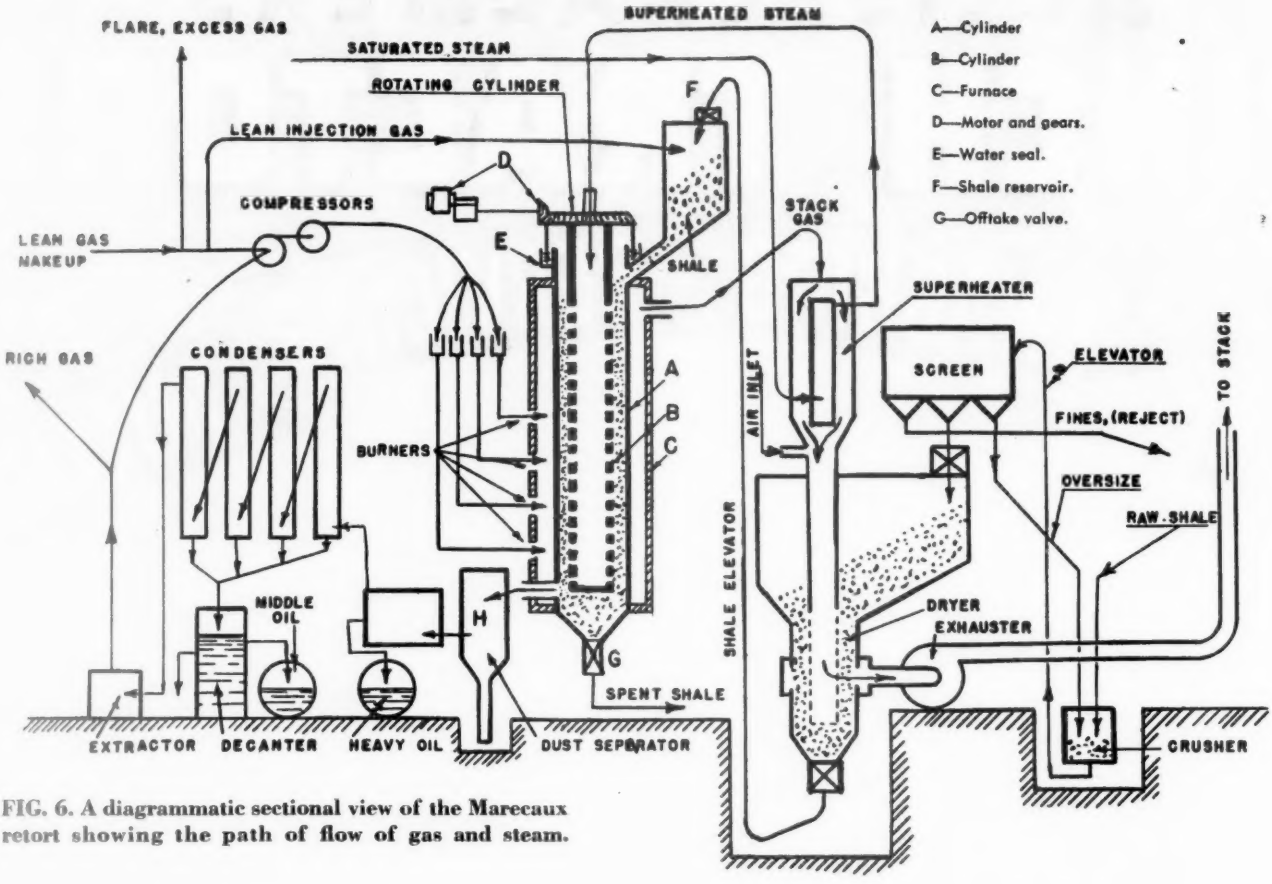


FIG. 6. A diagrammatic sectional view of the Marecaux retort showing the path of flow of gas and steam.

● **Kivioli tunnel oven.** Two kinds of processing were used in the treatment of Estonian shale and different types of retorts were necessary in each. One is known as the Kivioli tunnel oven, Fig. 7, an indirect internally heated retort. It was designed to overcome difficulties resulting from the caking tendencies of the Estonian kukersites. The shale circulates through the interior of a horizontal retort in small cars.

The Kivioli retort uses hot circulating gases as a heating medium without the use of internal-combustion steps, producing a vapor without dilution by gaseous products of combustion. The gas evolved is insufficient to supply the heat requirements of the process.

To treat 440 short tons per day the cylindrical retort forming the tunnel must be 174 ft. long and 6.56 ft. in diameter. It is divided into drying, distillation, and quenching zones that are separated by double sliding doors. Yield is 94 to 99 per cent of the Fischer assay yield. Upkeep is costly, however, and repairs take about a third of the time.

● **Pintsch retort.** The other Estonian process uses the Pintsch retort or generator (Fig. 1) in which pyrolysis of the shale is accomplished by internal-heating methods. The vapors resulting are diluted with gaseous products of combustion and an excess of gas is the result. The retort is a vertical cylinder 7.4 ft. in diameter and 20.2 ft. high, made of sheet iron lined with refractories. The principal problem has to deal with the kukersite itself, which softens and agglomerates to form clinkers that block passage of gases and heat transfer. It has been solved partly by allowing shale to travel rapidly and by classifying sizes more carefully. The oven is of simple construction and low cost. It yields about 80 to 90 per cent of the oil obtained by the Fischer retort.

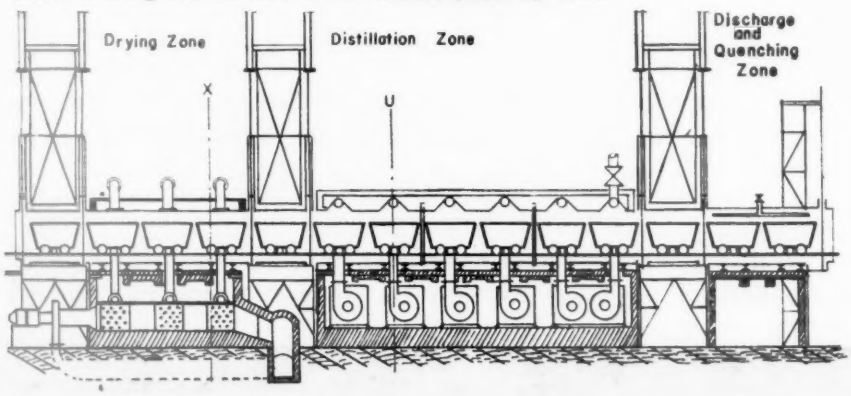
The German plans of extensive development included a combination of tunnel ovens and Pintsch retorts, three retorts to each oven. In this way tunnel ovens would be heated by gas from Pintsch retorts, saving the heating oil previously used in heating the ovens.

● **Other retorts.** The Bureau of Mines survey covers several other retorts in brief. There are the LaPorta retort, an Italian process used in Sicily and especially adapted to the shale in that area: the Fuschun retort, used in Manchuria for pyrolysis of poor shale; the Roma retort, used in Sicily for distillation of asphaltic limestone; the Lurgi retort, a direct internally heated process with a gas-circulating system, and the Petit retort, developed at Grenoble, France, and as yet operated only on the small scale of 8 tons of shale a day.

● **Conclusion.** Although the value of this survey may not be realized until long in the future, it will undoubtedly shorten the time for development of oil shale mining in this country.

One point stands out in the study of various retorts and that is the special handling needed for each kind of shale. Long and diligent testing of pilot plants with the shale to be used appears to be the only path to economical operation regardless of past experience in treating other shales. ★★★

FIG. 7. Longitudinal view of the tunnel (Kivioli) oven.



Development of Amana field in Venezuela

By **REX WATSON,** Drilling and Exploration Company

EXCLUSIVE

ALTHOUGH the first oil well in the Amana field of Venezuela was drilled in 1928 by the Gulf Oil Company, the second oil-producing well was not completed until this year. The first well was drilled to a depth of 4100 ft. and completed flowing for an initial production of 60-75 bbl. a day. Development of the prospective field was postponed until Drilling and Exploration Company of Dallas, Texas, drilled a 5000-ft. dry hole west of the discovery well in 1943.

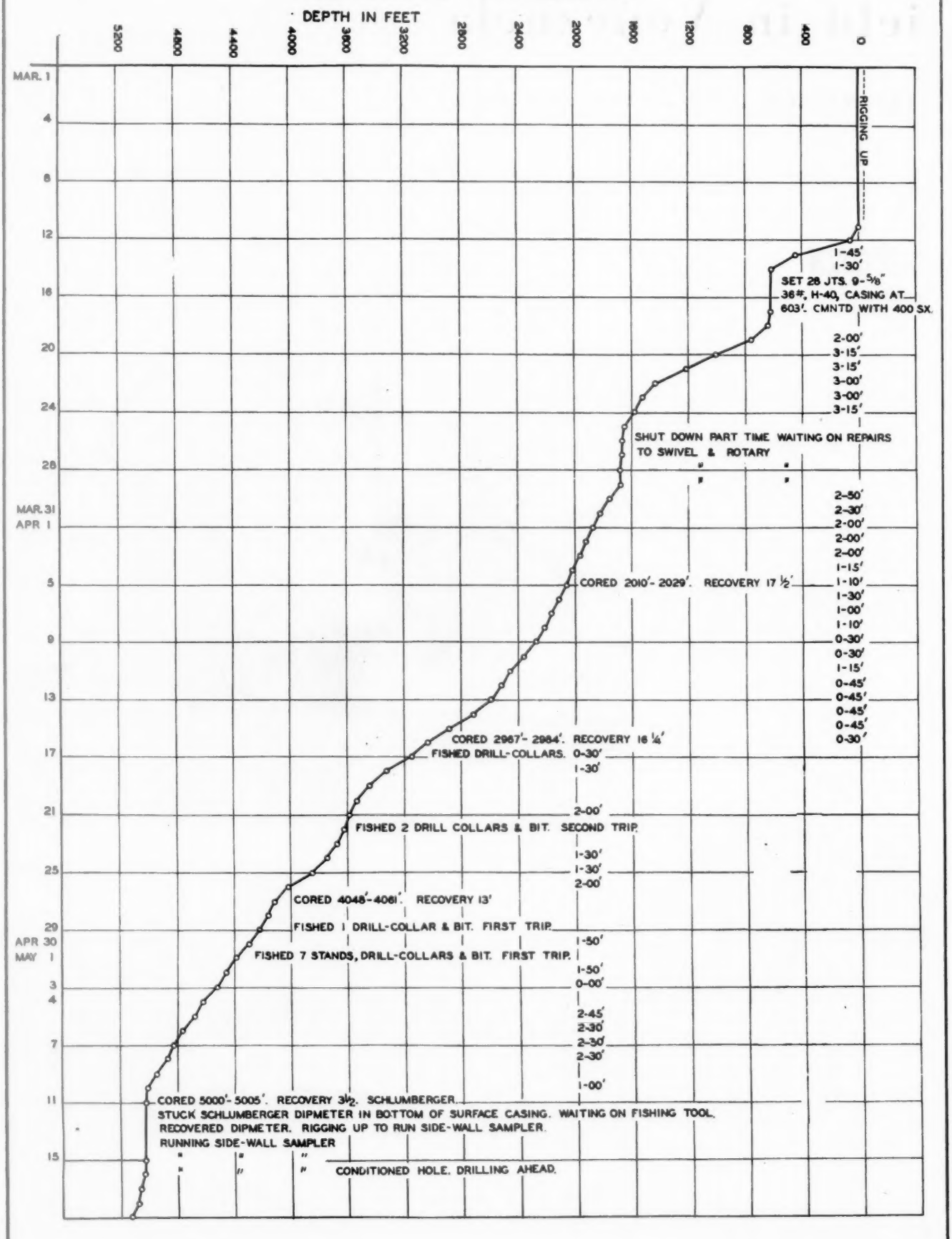
The prospect was taken over subsequently by the Guasare Oil Company and drilling operations were revived early this year by beginning well No. 3. The drilling time curve for this well (Fig. 1) shows the relatively slow progress made in drilling to a total depth of 5300 ft. Rock bits had to be used almost all the way, and most of the weight of the drill pipe was kept off the bits to prevent the hole from becoming crooked, because the formations in this area are broken and the dip of the beds is steep. More than forty 8⅝-in. rock bits were used in drilling the well. Some difficulty was caused by occasional loss of circulation. Very little drilling mud conditioning materials was added to the natural mud formed from the formation material drilled.

Guasare Oil Company's first well, Amana No. 3, was drilled to a total depth of 5300 ft. Casing was set at 5129 ft. with 500 sacks of cement, and the casing was perforated for production from two oil-saturated sections in the Eocene zone from 3188 to 3955 ft. Initial flowing production from these sections was 400 to 500 bbl. a day of 31-API gravity oil.

Portable power-type rig drilling Amana No. 3 in the Amana field for the Guasare Oil Company.

Above, right, is the camp at the Amana field headquarters and below it are the dining room and kitchen. All the buildings were transported to the site from Lake Maracaibo by trucks.

FIG. 1. DRILLING TIME ANALYSIS OF THE GUASARE OIL COMPANY'S WELL, AMANA No. 3.
(Drilling and Exploration Company, Inc.)



FROM TOP TO BOTTOM....

The Axelson name is known in every petroleum producing field throughout the world. It is best known for the great line of Axelson Deep Well Plunger Pumps and for the famed, long life Sucker Rods which actuate these pumps to the greatest pumping depths.... Axelson also supplies many other items of petroleum production equipment, *from top to bottom of the well*.... Stuffing boxes, polished rods, sucker rod couplings, paraffin scraper couplings, and the unparalleled Axelson Seat and Ball on which the fluid column rests.... Every Axelson product is manufactured to quality first standards in the Axelson Plant where the complete job, from foundry to shipping, is done.... Axelson petroleum production equipment is *right* from *top to bottom.*

Stuffing Boxes
Polished Rods
Sucker Rods
Sucker Rod Couplings
Deep Well Plunger Pumps
Seats and Balls

AXELSON MANUFACTURING CO.

PLANTS—6160 So. Boyle Avenue (P. O. Box 98, Vernon Station), Los Angeles 11, Calif. • 3844 Walsh Street, St. Louis 16, Missouri • OFFICES—50 Church Street, New York City 7 • National Bank of Tulsa Building, Tulsa 1, Okla. • Avda Pte. R. Saenz Pena 832, Buenos Aires, Argentina • DISTRIBUTORS—Jones & Laughlin Supply Company • Great Northern Tool & Supply Company • C. C. McDermond, Apartado 331, Maracaibo, Venezuela • Industrial Agencies, Ltd., San Fernando, Trinidad, B.W.I.

AXELSON

PETROLEUM INDUSTRY EQUIPMENT

THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

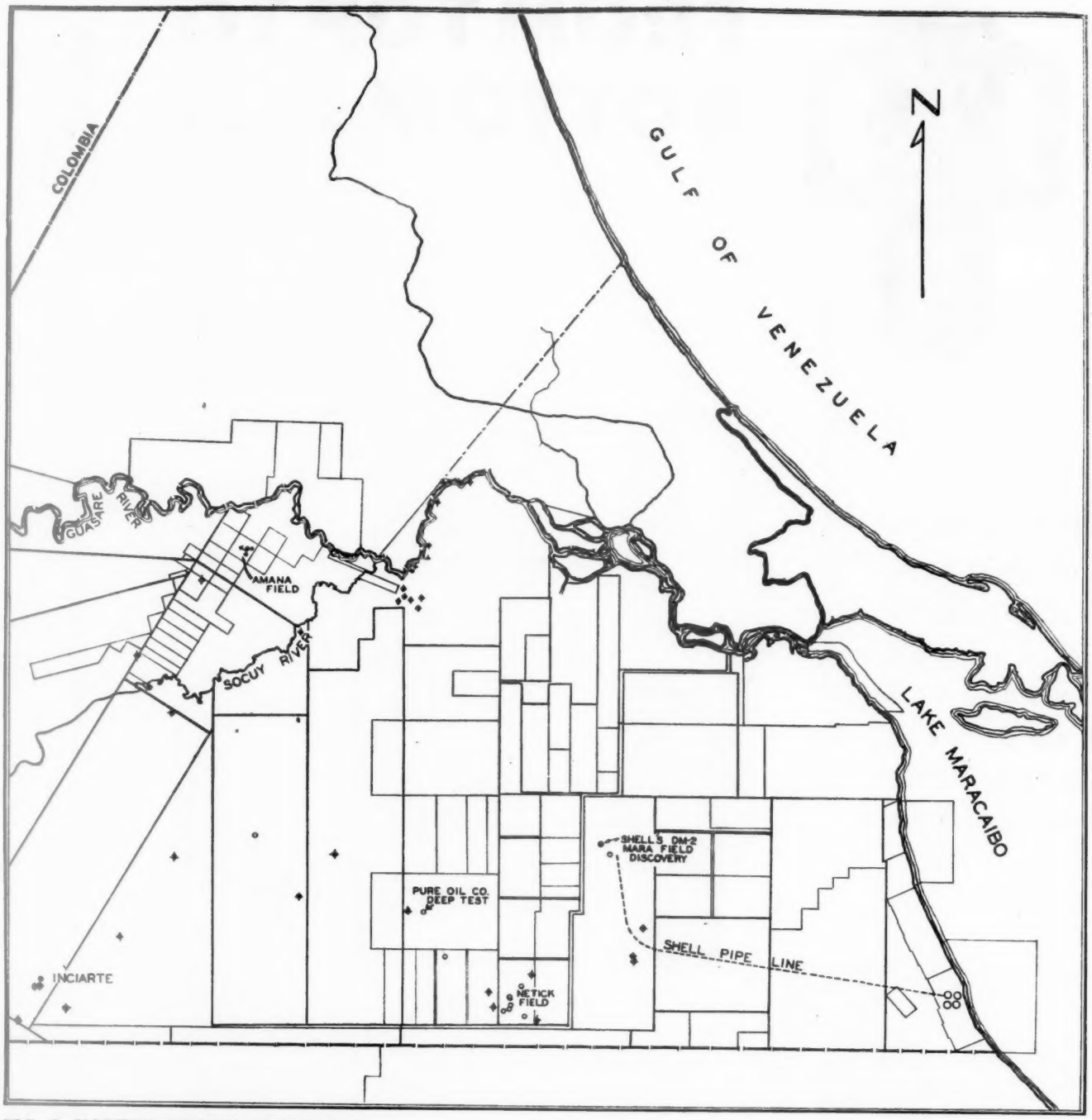
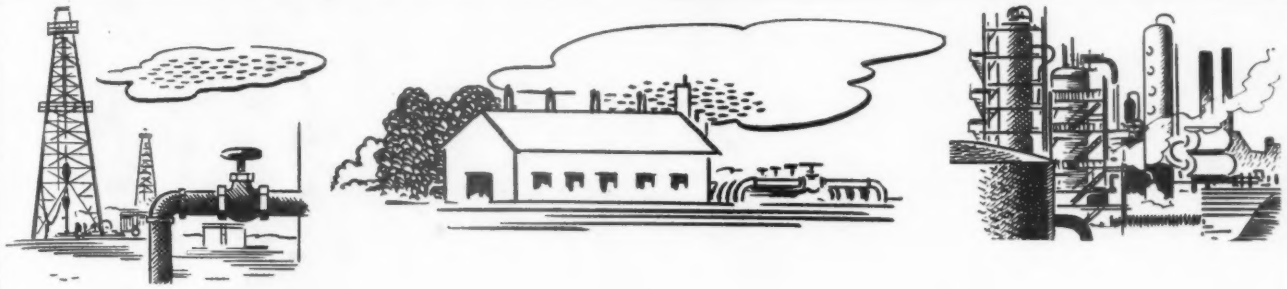


FIG. 2. NORTHWESTERN VENEZUELA.

Left, bridge for handling supplies over Socuy River to the Amana field.

The drilling rig has been moved to the location for well No. 4 and drilling is now under way. The approximate spacing of the four wells in the Amana field near the center of the Amana parcel is shown on the map of Northwestern Venezuela (Fig. 2). The field is situated about 18 miles northwest of Shell's operations in the new Mara field.

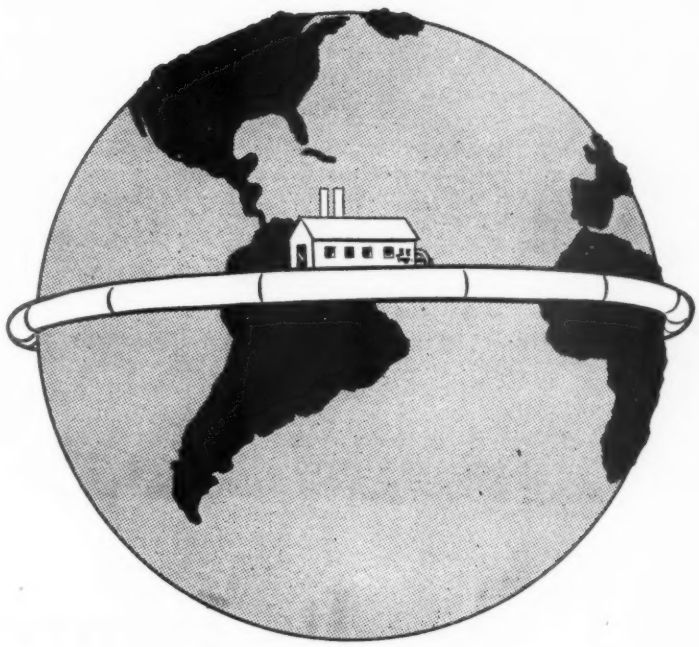
A bridge over the Socuy River near the camp was built with some old boiler shells used as foundation. The bridge timbers were bolted to pipe laid along the edges of the bridge to prevent them from washing away during occasional high water. ★★★



Complete Pipe Line Construction Facilities for World-Wide Service!

To better serve the petroleum industry and related industrial and business enterprises throughout the world, Williams Brothers' trained organization of engineers, skilled mechanics and construction crews is fully equipped with the most modern construction equipment, materials and supplies.

We are equipped to establish general headquarters, adequate warehouse properties and modern camps on pipe line and other construction projects to provide convenient, efficient working conditions and safe, sanitary, comfortable living quarters for employees anywhere.



PIPE LINE ENGINEERS CONTRACTORS
Williams Brothers Corp.

Thirty-five years' experience in building 35,000 miles of pipe lines, pump stations, river crossings, terminals and other important construction work on three continents is available in the building and development of nations and industries.

WILLIAMS BROTHERS CORP.

ENGINEERS — CONTRACTORS

Oil • Gas • Gasoline • Water

Pipe Lines and Pump Stations

NEW YORK • TULSA • ATLANTA • HOUSTON

CHINA—Its future in petroleum*

By **ARTHUR D. SMALL,** *Petroleum Consulting Engineer*

CHINA—an individualistic country of the Asiatic Continent and the Far East, with some 3,769,938 square miles of territory within its borders and some 430,000,0000 people to build it eventually into an industrial power. Compared to the United States of America China is larger in area and has at least three times the population. The molding of this immense population into a unified democratic people and the development of this vast land area, is a task of gigantic proportions. In the writer's humble opinion, the present premier of China, General Chiang Kai-shek, made the first outstanding move in this direction and, through the hardship of war, men have emerged with a clear vision and a strong will to reach their industrial goal.

EXCLUSIVE

Petroleum, as in all oil producing countries of the world, is one of the greater industries. With the exploration and development of petroleum other industries are opened up, not forgetting the building of roads, highways, and railroads, which in turn create the faster movement of goods to the main centers of distribution, and petroleum lubricates and provides the power to keep the wheels turning. The oil men of China have this thought and there is every indication that exploration and development will move forward at a rapid pace in the years to come. If this development is not hindered by the many difficulties yet to be overcome China has good possibilities of becoming self-sufficient in crude oil supply. There are at least nine

A. D. Small

*This article is based on data accumulated during a trip through China early in 1946 by the author, who takes this opportunity of expressing his thanks and appreciation to the oil men of China for their hospitality and aid. Grateful acknowledgement is also made to D. C. D. Shiah of the Natural Resources Commission of China, for making this article possible.

Draw on

...NS-ROGER

F.O.E.*

Since 1932, we have engineered, designed, and constructed SOME 50 PLANTS for dehydration of natural gas for main transmission lines—ranging from 50 to 2000 p.s.i. and from 7 to 300 MMCF daily capacity.

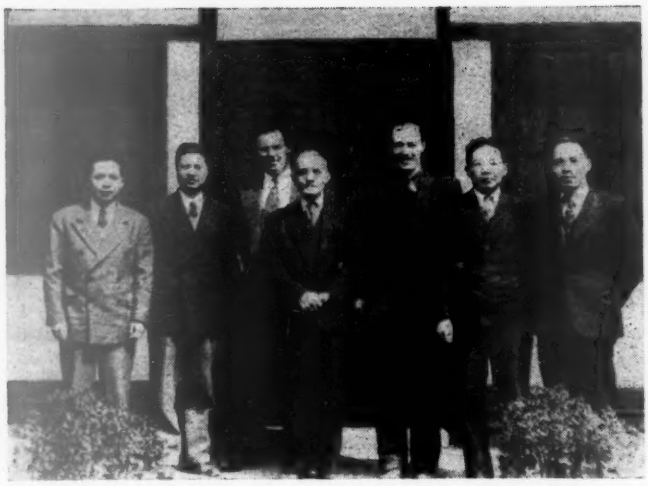
This is a measure of our experience.

In addition, we offer the advantages of UNDIVIDED RESPONSIBILITY: *Design* by our own engineers; *Manufacture* of special equipment in our own plant; *Field Construction* with our own crews and facilities.

*Fund of Experience

Stearns-Roger

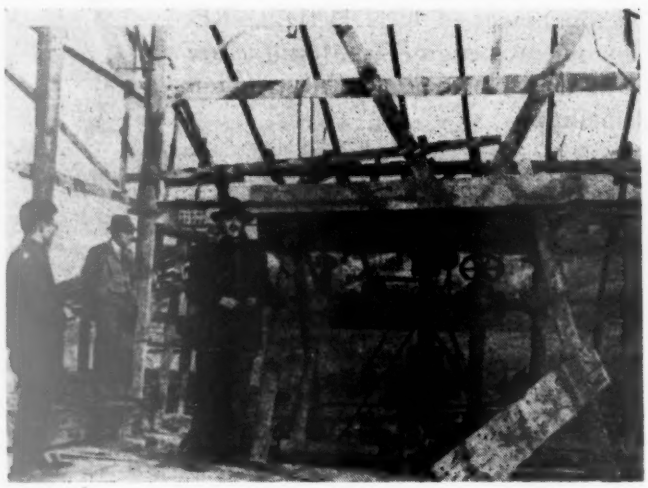
THE STEARNS-ROGER MFG. CO. DENVER, COLORADO



Group of oil men at Kansu Petroleum headquarters, Chungking, China: Mr. Tsuo, Mr. Woong, Mr. Shanley, Dr. Egloff, Mr. Small, Mr. King and Mr. Kuo.

Nanking Road, Shanghai, China. New headquarters in the Far East for oil men.

Well No. 94, Shikukoko, is flowing a little oil by heads.



Eddy Bien, Chinese geologist, standing on the axis of the Shikukoko anticline. Note—steep dip of rock outcrops.

recognized areas in China (excluding Manchuria) that have favorable oil possibilities. Those areas are situated all the way from the extreme northwest part, where there is very little cultivation and practically no population, through to the coastal area where we find cultivation to the extreme and dense population. Climatic extremes are also to be noted with sub-freezing temperatures in the north to semi-tropical temperatures in the south. Distances from the areas in the northwest to the areas of product demands become mainly an economic problem requiring careful planning before any oil exploration and development program is undertaken, whereas in the area of product demands there is the problem of extreme cultivation and the farmer population, which will possibly be troublesome in an oil exploration and development program. In view of such facts, three areas have been chosen for oil exploration and development, based on their strategic location and in the priority listed, i.e., Taiwan, Szechuan, and Kansu, and it is on these three areas this article is based.

Taiwan has the marked advantage of refining facilities already in existence. It is reasonably close to the mainland of China and centrally situated for delivery of products to the terminals at Hongkong, Shanghai, and other intermediate points. Distribution of products inland will be made by barge and railway.

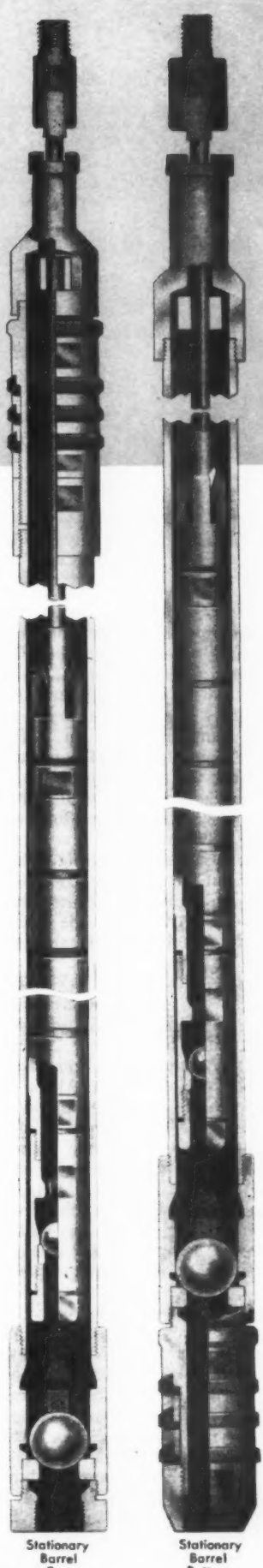
Szechuan, in central China, is a highly populated area and ideally situated from the viewpoint of product demand, for it is sufficiently far inland to make deliveries from coastal ports expensive and difficult. Further, there is every indication of very large gas reserves in this area. This gas can be very valuable as a replacement for coal, particularly in the salt industry, as well as in power plants and cement factories, after gasoline has been extracted.

Kansu, in the northwest part of China but closest of all the favorable basins in the northwest to the area of product demand, already has one commercial oil field in production, including a small refinery that is supplying the local market demand. This area is most important, for an increase in crude oil reserves through discovery of production on other known structures would immediately warrant the construction of a pipe line through to the area of product demand.

The National Resources Commission of China is a government bureau the functions of which closely compare to those of the Department of Interior in the United States. As a branch of this bureau there is now a unified group of men trained in the various phases of the oil industry, under the direction of Dr. Wong Wen Hao. Although I am not sympathetic with the idea of government control of the oil industry in any country, it is my conclusion in this particular case that it is about the only way to get it started and well established. This means toward-an-end should not be construed as a barrier to American oil companies participating in the oil exploration and development program, for there was every evidence to indicate the willingness of the Chinese to welcome such participation.

● **Taiwan (Formosa).** Taiwan was a part of the Japanese Empire from 1895 up to the termination of World War II. As a result, secrecy in the development of oil has been fairly well maintained for a number of years. Such information on

Pay off faster with oilmaster PETROL "A"



Stationary Barrel Top Anchor

Stationary Barrel Bottom Anchor

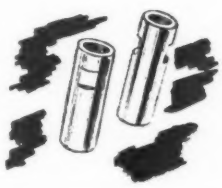
"A Superb Pump in a Quality Line"

—a broad statement, but let's analyze it. According to Mr. Webster, "superb" means "supremely good of its kind," and OILMASTER stands for quality in oil well pumps.

What other small bore pump offers these three outstanding features:

1 Hardened and honed, one-piece alloy steel barrel. (64 to 70 Rockwell C).

2 Heavy duty, one-piece pin-both-end chrome plated grooved plunger.



3 Heat treated API cages and fittings (all assemblies are equipped with API seats and balls).

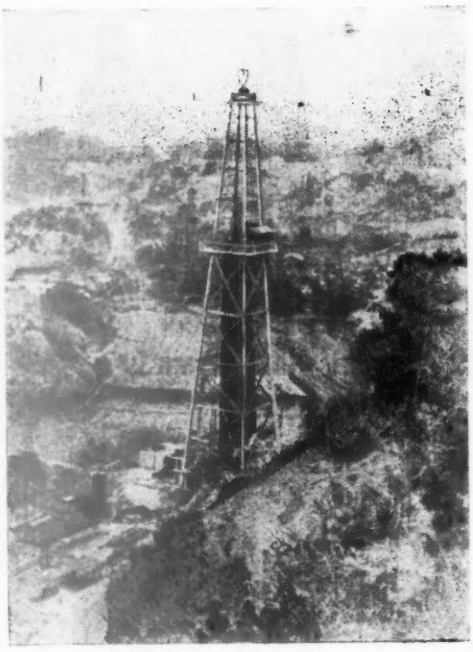
The Oilmaster Petrol "A" performs equally well in shallow "stripper" wells, or in deep wells of small volume.

FLUID PACKED PUMP COMPANY • LOS NIETOS, CALIFORNIA

OILMASTER PRODUCTS

DISTRIBUTED BY THE NATIONAL SUPPLY CO.
EXPORT: THE NATIONAL SUPPLY EXPORT CORPORATION
30 ROCKEFELLER PLAZA, NEW YORK

CO-DISTRUBUTORS: BERRY SUPPLY STORE, MURRAY TOOL & SUPPLY CO. OF TEXAS, INDUSTRIAL SUPPLY CO.



Kinsui Well No. 38, drilled to a total depth of 11,823 ft., and plugged back to 8283 ft. due to the bad condition of the hole. Work was suspended on this well due to the war.

Main street of the town of Lungchang, China.

oil development, as accumulated by oil companies interested in the Far East, was found to be excellent and of considerable aid in breaking down the Japanese lines of supply during the war.

The name Formosa, in Portuguese, means "beautiful island" and, although I saw it in the aftermath of war, I could still see the island was well named. Taiwan is the Chinese name for the island meaning "terraced bay" and here again the name is most befitting. The roads throughout the island are very good and a railway is in operation over the entire length. The trip from one end of the island to the other by rail takes about 12 hours.

Taiwan extends from latitudes 21° 45′ to 25° 38′ N., and from longitudes 119° 18′ to 122° 15′ E. It has an area of 13,836 square miles, being about 225 miles in length and varying in breadth east to west from 60 to 90 miles. Along the central and eastern coast lies the mountainous area with the highest peak being 13,075 ft., while to the west, terraces are noted fanning out into the alluvial plains area.

The Japanese built electric power lines all through the west portion of the island, the power being supplied from hydroelectric plants. As a result of this, most of the oil field equipment was found to be powered by electric motors.

Japanese geological surveys of the surface structures on the island, correlated with the data developed through drilling, were found to be very accurate and commendable in the area covered; however, the alluvial plains area has yet to be surveyed by geophysical methods and it is this area where commercial quantities of crude oil are most likely to be developed. Taiwan lies within the petroliferous belt composed of Tertiary strata, which extends along the western coasts of the Japanese islands, and in Taiwan the stratigraphic section includes sediments of Tertiary age, including Eocene, Miocene, and Pliocene.

During the period of oil development in Taiwan, the Japanese have discovered seven producing structures, i.e., Shikukoko, Kinsui, and Chikuto, situated close to the town of Byoritsu in the northern half of the island, and Gyuzan, Rokusyukei, Chikutozaki, and Toshikyaku, in the Sin Yen district of the southern half. All these producing fields are situated along the foothills of the mountains. The folds closest to the mountains have west dips of 70° to 80°. In the second line of folding the dips are more gentle, being only 30° to 35°.

A total of 224 wells have been drilled in these fields of which 143 wells were successful in producing gas and/or oil, 64 wells were failures, and 16 wells were not completed due to drilling difficulties. In addition, 26 wildcat wells have been drilled on 12 surface structures to depths ranging from 825 ft. to 9900 ft., but were dry and abandoned.

Of the seven producing fields only three have produced oil in commercial quantities, i.e., Shikukoko, Kinsui, and Chikutozaki. The latest began to produce oil in 1938, but at the present time the wells are shut down. From and including the year 1936 up to the end of 1945 these three fields, according to Japanese records, have produced a total of 300,000 bbl. of crude oil, this averaging approximately 2500 bbl. a month, and 193,609,390 cu. ft. of gas per month over the same period. The gas is processed through gasoline absorption plants, averaging approximately 60,000 gal. per month over the ten-year period; however, it is to be noted with reference to the average monthly production figures that during the year 1945 production was considerably curtailed due to severe bomb damage.

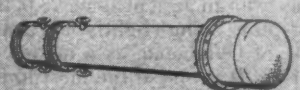
The total gas and gasoline produced from all the fields during the month of December, 1945, is recorded as being 81,232,183 cu. ft., and 24,320 gal. Crude oil production for the month of December, 1945, was 1150 bbl. Gravity of the crude oil averages 35.6 deg. Bé.

There are from three to seven productive zones in each field, consisting of sandstones showing poor assortment with low porosity and permeability. These sandstones vary in thickness of from 30 ft. to 140 ft. and at depths ranging from 300 ft. to 11,550 ft.

The present oil and gas fields have been developed in what one might call a typical Japanese manner, with each field closely related in each of the technical phases, i.e., drilling, casing, and production programs. Such a consistent relationship in development and production may have been due to the employment of men trained as mining engineers rather than in the petroleum engineering field. In disussions with these engineers, however, I found they had gained considerable knowledge and experience over the past years but were handicapped by lack of up-to-date information on the latest drilling and production methods. Further, no new-type equipment had been made available to them or developed by them for the last five to ten years. The usual method of completing a well was to rotary drill the hole to a point safely below the producing zone in the offset well or to as deep as they could go, then run and cement the casing or oil string. An attempted correlation was then made between the electric log (the type of instrument used in 1936) and the drillers' log, which, in the few cases I tried, was extremely difficult. With probable productive depths established then the gun perforator was used freely at these depths. In most cases the wells would start off producing gas but in a matter of days would be killed due to the entry of formation water. If the well could not be brought back on production it would be

DELIVERY
WHEN PROMISED

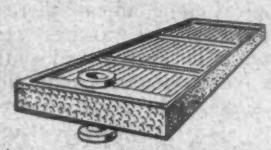
You can depend on prompt delivery when you buy heat transfer equipment from EFCO



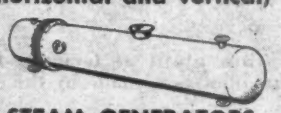
HEAT EXCHANGERS

REBOILERS

CONDENSERS



ATMOSPHERIC SECTIONS
(horizontal and vertical)



STEAM GENERATORS

JACKET WATER COOLERS
. . . and all other types of heat transfer equipment

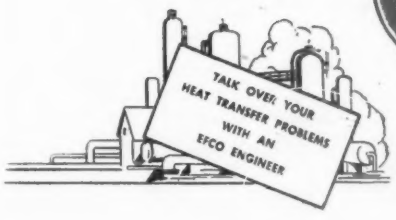
EFCO has an outstanding record for reliable delivery which insures the customer against losses from delays.

Among the apparent reasons for this ability to meet delivery promises are: Carefully maintained inventories, an efficient plant and highly experienced personnel.

But the real reason is harder to find. It is the importance of *your* job to the entire EFCO organization.

This conscientious attention not only assures you of delivery when promised, it also means that every piece of heat transfer equipment has the high quality to make it outstanding.

ENGINEERS & FABRICATORS, INC.
P. O. Box 7395
Houston 8, Texas



EFCO

HEAT TRANSFER EQUIPMENT

plugged off to a shallower zone and the operation repeated. It is my opinion that many of the wells now shut down or abandoned could yet be producing large quantities of gas and/or oil if the Japanese methods and equipment had maintained stride with the oil industry in the United States. One of the Japanese engineers stated that upon capture by them of the Palembang, Sumatra, D.E.I., oil fields, a bottom hole pressure bomb was immediately flown to Japan and the Japanese had been endeavoring to duplicate this instrument but to his knowledge had been unsuccessful.

Of the seven producing fields in Taiwan it is my opinion that only one field has been fully developed, this being the oldest field, Shikukoko. Many locations remain to be drilled in the six remaining fields. A drilling program is not advisable, however, until a complete subsurface study has been made of these fields. The use of nitro-glycerine to enlarge the bore hole of the producing horizon in the old wells at Shikukoko has not been attempted by the Japanese.

The oil field equipment noted at the various fields throughout the island was in most cases made in Japan but was an exact duplication of American equipment. Casing, gate valves, drill pipe, drawworks, mud pumps, derricks, etc., had in some cases the American manufacturers mark embossed on them, so close was the duplication. At the Kinsui field there was one heavy all-American drilling rig, except for the power end, which consisted of two 250 hp. Japanese electric motors. This rig had been used to drill the two deepest wells in Taiwan, i.e., Kinsui well No. 32, which is producing 6 bbl. of water, 5 bbl. of oil, and 40,000 cu. ft. of gas per day, with a tubing pressure of 75 lb. and from a total depth of 11,550 ft., and Kinsui well No. 38, which was drilled to a total depth of 11,823 ft. but, due to the bad condition of the hole, was plugged back to 8283 ft. and work suspended in 1945.

Upon my entry into the Chikutozaki field, which is the most southerly field, the Japanese advised me I was the first white man to enter this field and area. No soldiers had entered this area up to that time.

Stratigraphic section

Age	Formation	Lithological	Thickness in meters
Cretaceous	Chenghsiangyen.	Conglomerate, red-purple sandstone and shale...	500 to 2650
	Chungking, including Kuangyuan or Chiating.	Purple-red and bright red colored shale or clay in altercation with gray-yellow and occasionally red colored sandstone. Locally conglomerate and thin limestone beds.	1000 to 2500
	Tzelinching, including Chiangyou	Varigated shale and gray or yellow sandstone with two or more beds of limestone in the lower or lower middle part. Instraformational or basal conglomerate in the border regions.	200 to 500
Jurassic	Hsiangchi—coal series	Gray sandstone with several intercalations of shale and coal seams.	200 to 700
Triassic	Chialingschiang or Patung	Thin to moderately bedded dolomitic limestone (Chialingchiang) in the west and purple or red shale and limestone (Patung series) in the east.	200
	Fiesienkuan or Tayeh	Purple shale and sandstone locally with limestone at the base or in the middle (Fiesienkuan of western section) and thin to moderately bedded limestone (Tayeh limestone) in the east.	250 to 350

The most difficult task in reviewing oil development on Taiwan was in the translation of the records from Japanese to English. In talking with the Japanese I found it necessary at times to discuss many of the problems in the Malay language. From these discussions there was sufficient evidence to indicate the military strategists of Japan had overlooked the oil potentiality of Taiwan in their lust to acquire Borneo and Sumatra as a source of crude oil supply. At the Port of Takao a large oil refinery had been constructed to process the crude oil from Borneo and it was from this point distribution of refined products was to be made to China. Another point of interest at Takao was the reef limestone outcropping that, from observation, had south and east dips indicative of a possible anticline. Upon questioning the Japanese geologist on why no geological survey had been made of this area, I was informed this area had been a naval reserve and was taboo.

It is impossible at this time to make any predictions on the probable oil and gas reserves of Taiwan, for much exploration work remains to be carried out; however, it is my opinion that Taiwan in the future will be a source of crude oil supply for China.

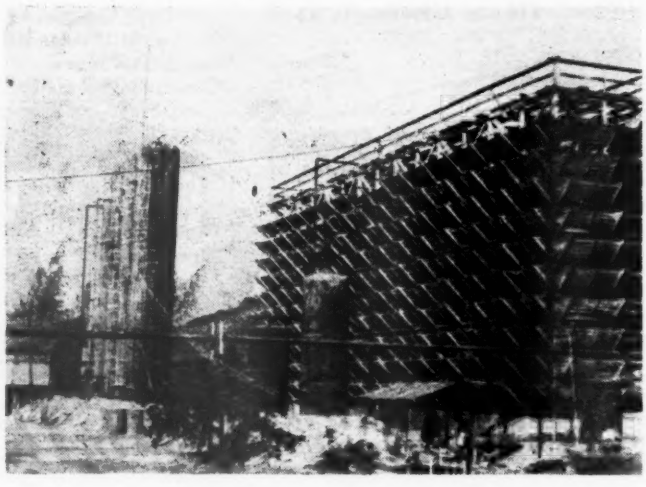
● **Szechuan.** The Szechuan Basin has Chungking as its capital and lies approximately 1100 miles by air due west of the Port of Shanghai. The basin extends over an area of some 75,000 square miles, this being slightly larger than the State of Oklahoma, as a matter of comparison. It is one of the most highly cultivated areas in China.

Through discussions with the Chinese geologists I found the formations within the basin mostly of Cretaceous age, with older formations exposed along anticlinal axes. Crude oil has been noted in various horizons in the Cretaceous, Jurassic, and Triassic, with the important horizons appearing to be in the lower part of the Cretaceous, the upper and lower part of the Jurassic, and the upper part of the Triassic. The Chinese surface geological maps indicate there are some 100 anticlines of varying size, mostly situated in the eastern and southern part of the basin, thereby leaving a large era to be surveyed by geophysical methods.

The stratigraphic section shown above was prepared by Dr. C. Y. Hsieh,

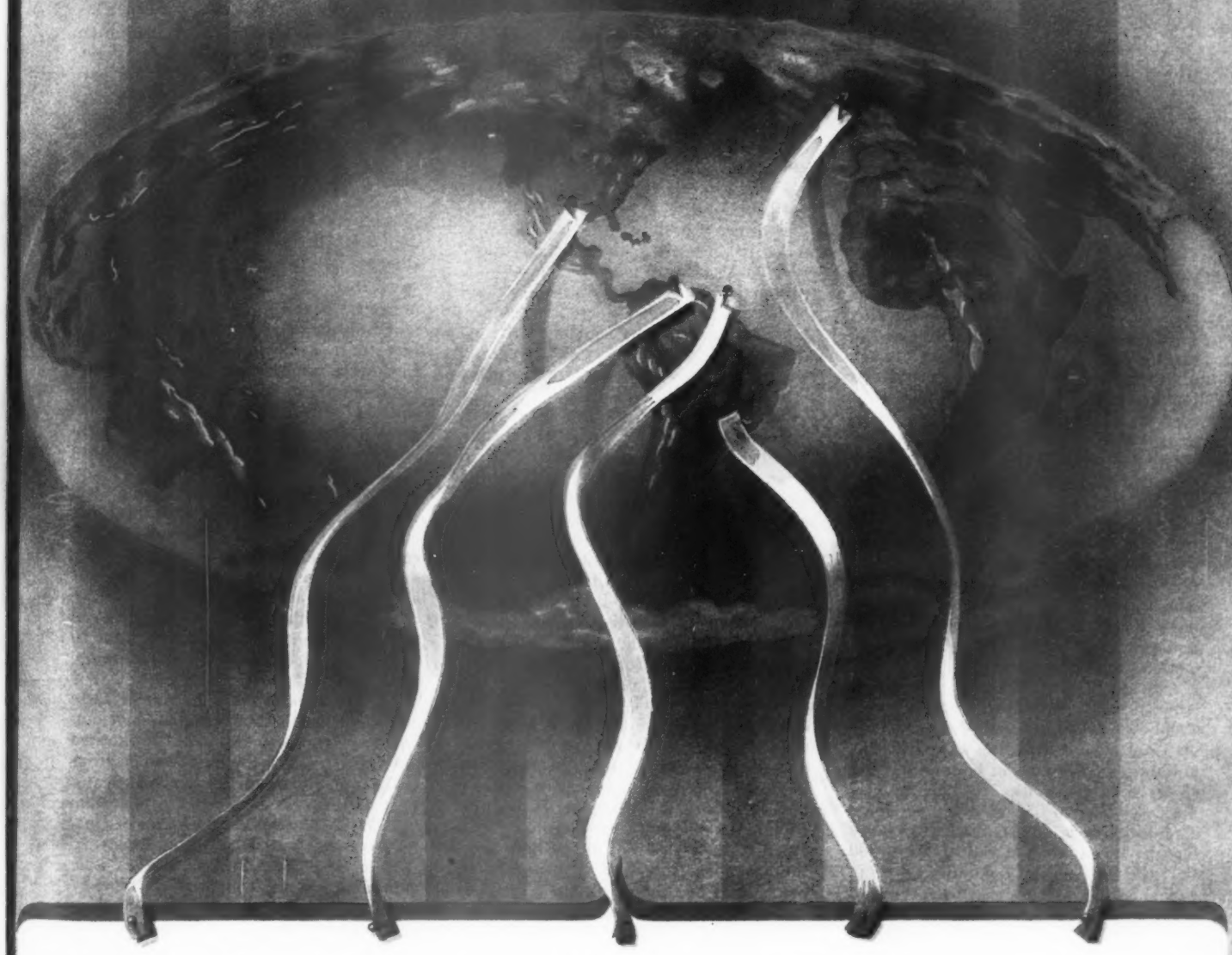
Chikuto Well No. 7 is producing some gas from 2366 ft. Here are Mr. Chang, Mr. Bien, Mr. Hisazumi, Mr. Small and Mr. Shoshima.

Gasoline absorption plant at Gyuzan field, Sin Yen District. This plant was made by the Japanese.



Wherever men drill for oil there's

SCHLUMBERGER



Schlumberger Well Surveying Corp.

Houston, Texas

Serving the United States

"Schlumberger" Surenco S. A.

Caracas, Venezuela

Serving: Mexico, Venezuela, Colombia, Brazil, Ecuador, Peru, Trinidad, Cuba, Haiti and Santo Domingo

Schlumberger Overseas

San Fernando, Trinidad

Serving: Egypt, Netherlands East Indies, Borneo, Burma and India

Compania de Investigaciones Geofisicas Schlumberger

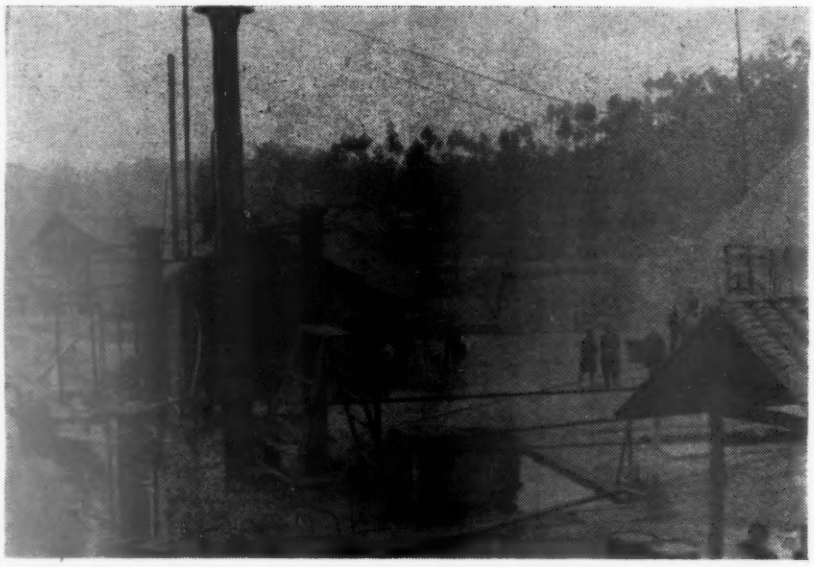
Buenos Aires, Argentina

Serving: Argentina and Chile

Societe de Prospection Electrique

Paris, France

Serving: England, Europe, and French Colonies



Homemade experimental gasoline absorption plant at Shengtungshen Well No. 2.

Director of the Mineral Exploration Bureau of the National Resources Commission of China.

During the year 1936 the National Resources Commission formed the Szechuan Oil Administration to prospect for crude oil. Their equipment consisted of two old style German rotary rigs that are very cumbersome and difficult to move from one location to another, considering the poor type of roads and mobile equipment available. Even in the face of such difficulties, however, it has been possible for this administration to drill four wells over a wide area. Of the four wells drilled, one was a dry hole, one was not completed to the producing horizon due to the urgent need of the equipment in another basin, and two wells were completed as commercial gas wells. A fifth well was being drilled in the northwest part of the basin during my visit. It is indeed commendable and should be most encouraging to the Chinese oil people to have started from scratch with very little equipment and out of three completed wells to have two producers.

One of the commercial gas wells, namely Shihyoukou Well No. 1, situated about 30 miles from Chungking, is drilled on a north-south trending anticline. The anticline is closed on both ends and shows very gentle dip, 15°, on the east limb and 35° to 55° on the west limb. The anticline is approximately 25 miles long by seven miles in width. About 300 ft. from the well is a notable oil seep, which, as the story goes, has produced many gallons of crude oil. The well was completed in the Triassic limestone at a plugged-back depth of 3696 ft., 5¾-in. casing was set to the bottom with 10 ft. perforated opposite the producing zone. At the present time tubing is set at the bottom of the hole and is only used to remove accumulated water and gasoline; the gas is produced through the casing. Upon completion of the well in 1941 an open flow test recorded half a million cubic feet of gas in 24 hr., and the shut-in casing pressure at 1550 lb. During December, 1945, the well produced at a regulated flow, to meet demands, an average of 37,000 cu. ft. a day with a casing pressure of 1140 lb. This well has not been acidized.

During the drilling of this well oil was noted in the mud in the slush pit; however, no tests were made of the possible productive horizons. Oxygen bottles and home-made containers of well casing are filled with gas directly from the well then transported to the vicinity of Chungking where they are sold and used in the place of motor fuel.

The second producing gas well, Shentengshan No. 2, is situated approximately six miles from the town of Lunchang and approximately 125 miles southwest of Chungking. The structure is an anticline with rather flat vertex. Its axis is in a northeast southwest direction. It is approximately seven miles in length by two miles in width, with dips of 10° to 16° on the southeast limb and 15° to 36° on the northwest limb.

During the drilling of this well a gas blowout occurred from the Triassic at a depth of 2468 ft., requiring about one month to get the well under control. At a depth of 2805 ft., the drill pipe froze and attempts to free it were unsuccessful. Salt water was encountered at this depth in quantities estimated at 300 tons per day. In talking with the men on location I found the well had been completed with 50 ft. of drill pipe left in the bottom of the hole and 2250 ft. of drill pipe were being used as tubing. Through the tubing salt water is flowed to a salt water evaporating plant and the gas is processed through a very inefficient home-made experimental gasoline absorption plant that produces about one gallon of gasoline per 10,000 cu. ft. of gas. The residue gas is burned at the salt water evaporating plant and at a brick and tile plant, the surplus being burned to the air.

Upon completion of this well, a test was made that showed a closed-in pressure of 1175 lb., and an open flow rate of 5,000,000 cu. ft of gas a day with a gasoline content of 0.11 gal. per 1000 cu. ft.

From the data presented it will be readily seen that with light portable drilling equipment many of the structures in this basin can be tested and within a few years there is an excellent possibility that gas reserves will be built up in sufficient volume to warrant a Fischer-Tropsch Synthine or Hydrol Process plant. Further, it is a good possibility that during the drilling campaign crude oil in commercial quantities will be discovered. Exploration work in this basin is really in its infancy. The well being drilled during my visit was testing the Kiangyu structure where a sizable oil seepage exists. The location of the well is about half a mile west of the coal mine at Yunghsing and it is believed to be the best location for testing oil possibilities of the entire northwestern part of the basin.

We cannot pass through Szechuan without mention of the famous Tzeliutsing gas and brine field, which has been producing for more than 2000 years. In all, some 350 wells are still producing large quantities of brine and approximately 2,800,000 cu. ft. of gas daily. The gas is burned under the salt water evaporation pans. It is regretted time did not permit my visiting this field as it, undoubtedly, is a most interesting field considering its history.

● **Kansu.** The Kansu Basin, in the northern part of China, extends in a northwesterly direction through the province for a distance of some 675 miles. In the western extremity the width is approximately 96 miles but narrows to a width of a few miles to 55 miles in its eastern part. It is bordered on the north and south by prominent mountain masses.

In this basin the Chinese during 1939 opened up what may be termed their first commercial oil-producing field, which came as a war measure to insure to some extent a crude supply to help wage war against their aggressors. Again, the Chinese found themselves lacking in oil field equipment, and again they must be commended for doing so much development with so little.

The anticlinal folds in the Kansu Basin are developed in Tertiary beds and outcrops of Tertiary sediments of limited areal extent fringe the basin and occur as outliers in the basin itself. The greater part of the area between the mountain barriers is filled by a thick series of Quaternary silts, gravels and sand dunes.

The present oil field known as Laochunmiao is approximately 515 miles by road northwest of the town of Lanchow and approximately 37 miles southeast of the smaller town of Yumen. Within the Yumen area other surface structures have been noted but no detailed survey made. There are, however, two structures on which some detailed work has been carried out, i.e., Wenchushan and Minho. Both structures have similar geologic features to that of Laochunmiao, and will in all probability be tested in the very near future.

The Wenchushan structure is found in

The New Home of ENSIGN'S Chicago Branch Factory

2330 W. 58th ST.
CHICAGO 36, ILL.
TELEPHONE
HEMlock 2500

Complete Stocks and Service

ENSIGN'S new Branch Factory address in Chicago is 2330 West 58th Street, Chicago 36. At this new location ENSIGN has invested in newer and larger facilities for just one reason—to give service.

Complete engineering services and stocks of Natural Gas and Butane-Propane Carburetion equipment for our customers and accounts in the Mid-West are maintained.

We cordially invite you to visit us in our new quarters.

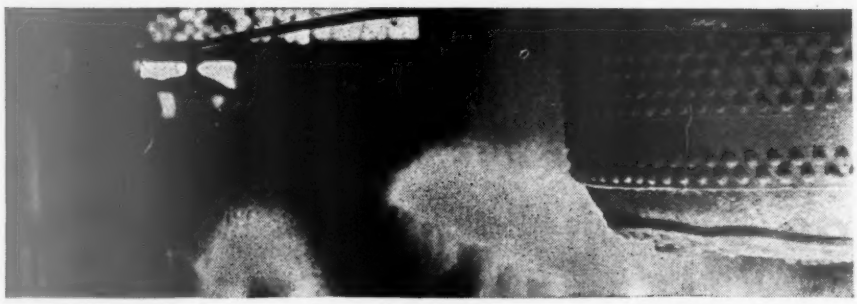
ENSIGN CARBURETOR COMPANY

7010 SOUTH ALAMEDA STREET • P.O. BOX 229 • HUNTINGTON PARK, CALIFORNIA

BRANCH FACTORY: 2330 WEST 58th STREET, CHICAGO 36, ILLINOIS

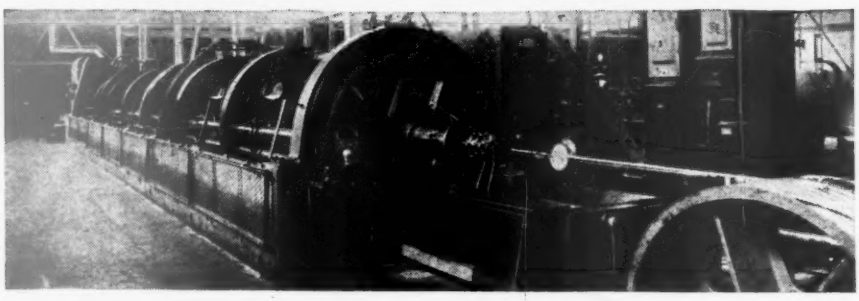
"Pioneers in Efficient Carburetion" • Established 1911

FROM THE MAKING OF THE STEEL—



THROUGH PROCESSING THE WIRE—

TO FABRICATING THE WIRE ROPE—



WICKWIRE SPENCER WIRE ROPE

is safeguarded by continued, careful control to assure the utmost in performance, safety and long life. Wickwire Spencer Wire Rope is available in all sizes and constructions—both regular lay and WISSCOLAY *Pre*formed.

HOW TO PROLONG ROPE LIFE AND LESSEN ROPE COSTS...

Thousands of wire rope users—old hands and new—have found "Know Your Ropes" of inestimable value in lengthening life of wire rope. Contains 78 "right and wrong" illustrations, 41 wire rope life savers, 20 diagrams, tables, graphs and charts. For your FREE copy, write

Wire Rope General Sales Office, Palmer, Mass.

WICKWIRE SPENCER STEEL DIVISION
The Colorado Fuel and Iron Corporation
THE CALIFORNIA WIRE CLOTH CORPORATION

EASTERN GENERAL SALES OFFICE 501 Delaware Ave., Buffalo 2, N. Y. | EXECUTIVE OFFICES DENVER 2, COLORADO | WEST COAST OFFICES OAKLAND 4, CALIFORNIA | KEY CITY OFFICES SEE PHONE BOOK

the vicinity of the town of Suchow and is approximately 66 miles east of the present producing field. The Minho structure is just west of the town of Lanchow. Both structures are ideally situated from the viewpoint that with increased crude oil reserves in the Kansu area they will be close to the right-of-way of a future pipe line between Laochunmiao and Lanchow or even through to Hankow.

The surface elevation at the Laochunmiao field is estimated to be 8167 ft. above sea level. Structurally the field is situated on a half dome anticline; it trends in a general east-west direction with 15° to 20° dips on the southern flank of the central portion, getting steeper toward the ends, with extreme dips on the east and west ends. Seepages have been noted in the area for many years past.

Since 1939, up to the early part of 1946, a total of 26 wells has been drilled. Of this total 7 wells were drilled to the "K" sand found at an average depth of 660 ft., but six of these wells are now standing abandoned. This sand section was evidently lenticular, for it has not been found in the other wells. Well No. 1 was deepened to the "M" sand section found at a depth of 1980 ft., and is the deepest well in the field. Production from this well has been small, however, compared to the other producing zones. Eighteen wells have been drilled to the "L_1" and "L_2" sands found at an average depth of 1353 ft. and 1480 ft., respectively. The thickness of these sand sections averages 5 ft. for the "L_1 and 57 ft. for the "L_2". At the present time only 12 wells are being produced to supply crude for the small refinery at the field and for the local needs of the area. The average monthly production rate of the 12 wells, over a 21-month period, was 3600 bbl. per well per month, or 120 bbl. per well per day.

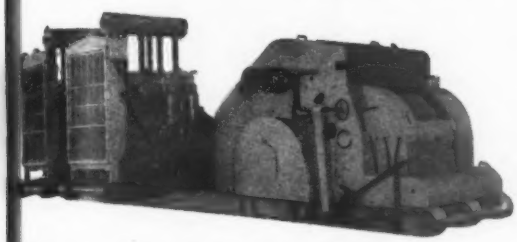
Due to the lack of laboratory equipment, bottom-hole pressure bombs, and other of the many pieces of equipment so important to the petroleum engineer in the field today, the data necessary in estimating oil reserves was not available. Using very tentative figures, however, a number of assumptions, and an estimated productive acreage of 1375 acres, it was possible to arrive at an estimate of between 89,000,000 and 100,000,000 bbl. of oil in the "L_1", "L_2" sand sections at the original reservoir pressure.

The crude oil produced at Laochunmiao has a Baumé gravity of 32.2 deg. and is a paraffin base oil, with a 15.5 per cent paraffin content. This large percentage of paraffin is causing operating difficulties, and it has been found necessary to scrape the tubing of each well almost every day, and no doubt wax deposition on the face of the productive sand will make itself known in the near future.

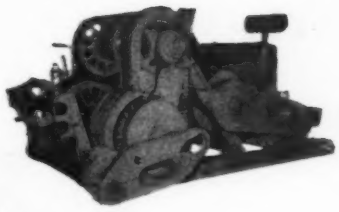
The Kansu Basin has every indication of being a large crude oil reserve area for China in the future.

In conclusion and in my humble opinion, China's future in building up a petroleum industry is bright and holds excellent possibilities. ★★★

"CARDWELL" DRILLING AND SERVICING RIGS



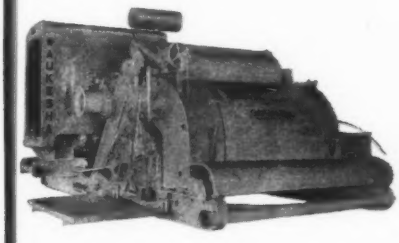
MODEL O—Twin-engine, double drum draw works for drilling to 8,000 feet with 4½" drill pipe. V-belts drive to pump and draw works. "Cardwell" chain transmission has three speeds forward and one reverse. Dual drum drives provide six speeds forward and two reverse to lower drum. Twin Disc friction clutches drive pump, draw works and rotary table. Engines and V-belts can be removed without disturbing bearing alignment.



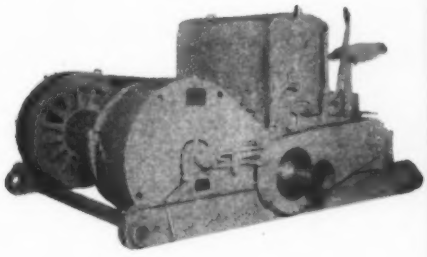
MODELS H, K or R—Combination rotary or cable tool (spudder or beam) double drum drilling rigs. Rotary drilling to 5,000 feet with 4½" drill pipe, cable tools to 7,500 feet, and servicing to 10,000 feet. Spudding assembly is interchangeable with rotary assembly in three to four hours on location. Beam and rotary can be installed on Models K and R, so change-over from rotary to cable tools or pumping can be made without rig changes. Friction clutch drives make it possible to "drill-up" through cave-ins, or lift tools without stopping spudder.

"CARDWELL" RIGS "FIT THE FIELD" FOR BOTH ROTARY AND CABLE TOOL OPERATIONS

Heavy-duty brakes are self-energizing, full wrap type. Brakes have positive equalization, are fully adjusted by single turnbuckle, and the woven asbestos lining is interchangeable. Demountable brake flanges are heat-treated for surface hardness and ground to furnish a smooth, polished surface. All chains are Diamond long life, high efficiency type. Shafts are ground to close fits from heat-treated alloy steel. Every wearing part is heat-treated for longest wear. All "Cardwell" rigs are light weight, fully portable and designed to fit within road limits. Single and double leg servicing masts, double leg drilling masts, and telescoping alloy steel pipe portable derricks are available. Day and night parts service is available from conveniently located parts stock stores. Operating and maintenance instructions and fully illustrated parts books are included with each rig. Spanish and English books are available for machines shipped to Latin-American countries.



MODEL S—Single engine draw works for drilling up to 4,500 feet with 4½" drill pipe, or work-over jobs to 10,000 feet. This rig is designed and built for fast drilling with one large engine which drives through "Cardwell" five-speed, seven-step transmission. Dual drum drives furnish ten speeds forward and two reverse. Rotary table has five speeds. Engines up to 202 HP are available.



MODELS Q, H, K or S—Four sizes of single drum servicing hoists for wells 2,000 to 12,000 feet in depth. Positive jaw clutches and SKF bearings insure a free-rolling drum. Rotary table drive assembly is available for Models H, K and S; spudder available for Models H and K.

MODEL E—Twin-engine, double drum draw works for drilling to 6,000 feet with 4½" drill pipe or workover jobs to 12,000 feet. Friction clutch high drive outside of transmission permits fast lift of block without shifting gears. Six speeds and reverse to both drums, and five speeds to rotary table. Either or both engines may be used to drive draw works, rotary table or pump. When rotating, no chains are running except to table, although catheads or drum may be engaged through friction clutches without stopping table or pump. Main drive chains run in spray of oil. "Cardwell" patented single bearing power take-off for both engines insures bearing alignment.

CARAVAN RIG—90-foot telescoping pipe derrick for drilling operations to 5,500 feet, or workover jobs to 10,000 feet. Derrick telescopes to one-half its length and is carried on semi-trailer with utility section. Engine operates hydraulic rams and winch for raising and extending derrick, and drives rotary table, light plant, washdown pump, air compressor, electric welder, and hydraulically raised telescoping doghouse. This is a complete portable drilling rig with which any draw works may be used. Rotary table and blocks are moved in place as a part of the derrick.

MOBILHOIST—Self-propelled, rubber tired, combination rotary or cable tool drilling or servicing rig for drilling to 1,500 feet with rotary, 3,500 feet with cable tools or 4,500-foot servicing jobs. "Cardwell" five-speed and reverse transmission — heavy-duty power take-off and axles—dual wheels—jaw clutch in lower drum —hydraulically-operated friction clutch in upper drum. Spudder and rotary drive are available.

CARDWELL ALL STEEL TRADE MARK REG. U.S. PAT. OFFICE
IS TRADE MARK INSURES HIGHEST QUALITY AT LOWEST PRICE

CARDWELL MFG. CO. INC.

FORMERLY ALLSTEEL PRODUCTS MFG. CO.
P. O. Drawer 2001 · Cable Addresses: ALLSTEEL WICHITA · CARDSTEEL, NEW YORK
Wichita, Kansas, U. S. A.

"CARDWELL" RIGS LAST LONGER AND REQUIRE FEWER REPAIRS

Japanese petroleum industry

By **JAN G. SCHAAFSMA***
General Petroleum Corporation

Wrecked plastics section of a Japanese chemical manufacturing plant, above. Remains of a unit, below, for making synthetic glass of the Plexiglas type in a large chemical plant. In the background, also badly damaged, is a nitric acid plant.

EXCLUSIVE

THE story of Japan's petroleum industry during the recent war is typical of the Japanese industrial picture as a whole. It is a tale of a small nation, weak in resources, low in accumulated supplies, and unresourceful in its attempts to make up for wartime shortages. Despite her large army of well-trained fighters and her strong navy she was doomed to lose the war on the day she started it because of her industrial shortcomings.

Japan's career of aggression began when she invaded Manchuria in 1931. At that time her total usage of petroleum products, consisting principally of imported materials, was only 17,000,000 bbl. a year, or less than the annual throughput of one major California refinery. In other words, one 50,000-bbl. per day U. S. refinery could have supplied the total military and civilian needs of this nation that defied the world when she invaded Manchuria.

Concurrently with her military ventures Japan began to build up her industries in an attempt to make herself more independent of imported raw materials and finished goods. The management of her industries was centralized in government sanctioned cartels or control associations for more efficient use of these valuable and limited materials. These cartels, and the management of industry, remained in civilian hands throughout the entire World War II and served much the same functions as our various governmental planning, allocation, and rationing boards.

With the China incident in 1936 Japan redoubled her efforts to prepare for the war she felt was inevitable in 10 years. The army received large sums from the government for prosecution of the war in China but actually used only about one-fourth of the money for that purpose. The remainder was used for the accumulation of war supplies and for the erection of various munitions plants. Both the army and navy built modern refineries that became the finest in Japan. Japan also imported all the steel, oil, rubber, machinery, and other critical materials that her limited foreign exchange could pay for on the world market. Her leaders knew, however, that the only way to procure the supplies of petroleum and metals that she needed to become a wealthy modern nation was to conquer East Asia and the Indies.

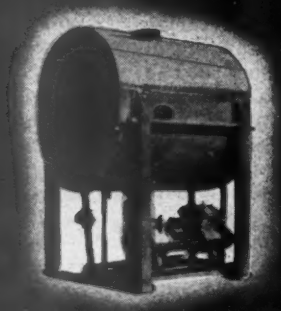
Let us pause for a moment to compare the potential strength of Japan with that of the nation she attacked in December, 1941. From an industrial standpoint, the one thing that stands out is that at the very beginning of the war, she was already scraping the bottom of the barrel in materials and manpower and could not further expand her production of many needed items. Her people were already working long hours and were on short rations with respect to clothes, building materials, and transportation. There was no huge civilian automobile industry to be converted into war industries, and no large supply of skilled mechanics. There were insufficient competent scientists and engineers to meet and conquer shortages and develop new weapons. In 1941 Japan was about as short of everything that could contribute to industrial expansion as we were in 1945. Although we may not have realized it at the beginning of the war, many of her industries such as steel and sulphuric acid, had already passed their peak year and were to decline steadily all through the war because of lack of materials and deterioration of plants.

*Jan G. Schaafsma was born in Hawaii, and received his primary education in Honolulu. Later attended California Institute of Technology, from which he received his B.S. in 1932, and his master's degree in 1934. Since 1934 to the present time, he has been a member of the Laboratories Department of General Petroleum Corporation in Los Angeles, and at the present time is supervisor of the Development and Experimental Section. During November and December 1945, he was sent to Japan with the United States Strategic Bombing Survey in the oil, chemicals, and rubber section.

MODERN EQUIPMENT FOR OIL OPERATORS

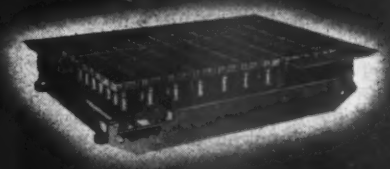
NEW DEAL
PIPE CLEANING MACHINES

. . . provide rapid, dependable and efficient operation. Built in three models and several sizes to meet varied requirements.



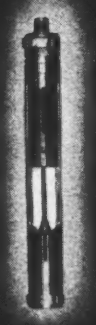
BANNON FEED WATER HEATERS

are designed to stand up under rough treatment. Easily portable yet ruggedly built, they provide an efficient heating and treating unit for drilling boilers.



BECK "MELLOBLU" GAS BURNER

Increases the capacity of the boiler beyond its normal rating, more complete combustion at low gas pressures.



"TOTCO"
DRIFT RECORDER

Provides immediately available permanent records for vertically controlled drilling. Due to simplicity and ease of operation by regular crew, operating efficiency of 98% is obtainable.

LUCEY

OTHER LUCEY EQUIPMENT

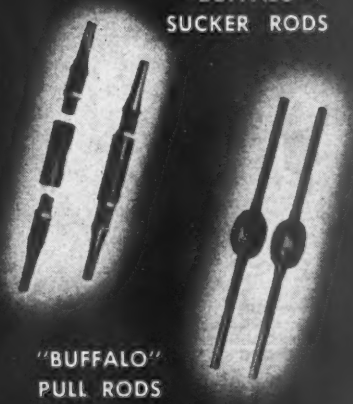
Lucey "Slim-Hole" drilling outfits.
Lucey Electric & Diesel Electric Hook-ups
Lucey Boilers & Insulation Casings
Wheland Rotary Drilling Equipment
Chain Belt Company—Sprocket & Roller Chain
Cable Drilling & Fishing Tools

Distributors of
Hughes Rock Bits & Tool Joints
Reed Rock Bits & Tool Joints

"COOPER"
DIE-FORMED BASKET

With this tool, it is not necessary to circulate, make hole or rotate in order to pick up rock-bit cones or other junk. The basket fingers scrape the bottom of the hole and catch everything in one grab.

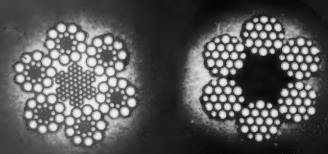
"BUFFALO"
SUCKER RODS



"BUFFALO"
PULL RODS

"BUFFALO" RODS

Scientific study of 85 years applied to steel analysis, forging operations, threading and machining assure superior performance of Buffalo Rods.

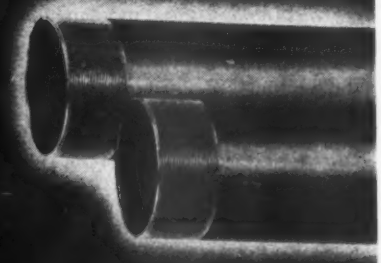


6x19
FLEXIBLE SEALE

6x19
WARRINGTON

UNION WIRE ROPE

Dependable and long lasting. Fabricated in different grades and in all standard sizes.



PITTSBURGH STEEL
SEAMLESS TUBULAR
PRODUCTS

Casings Tubing
Drill Pipe Boiler Tubes
Line Pipe

Exclusive Export Distributor

LUCEY EXPORT CORPORATION

233 BROADWAY . . . NEW YORK 7, N. Y.

Broad Street House, London, E. C. 2, England ● 811 Sterling Building, Houston, Texas ● Calle Defensa 320, Buenos Aires, Argentina
San Fernando, Trinidad, B. W. I. ● 615 8th Avenue West, Calgary, Canada

Despite having geared her entire economy to war, Japan in 1941 had a steel production of less than one-tenth of ours and a rubber consumption of similar relative proportions.

By 1941 Japan had built up her refinery strength to a crude capacity of about 90,000 bbl. a day, much of it obsolete. As her own crude production was only about 7000 bbl. per day in 1941, and as her average annual crude runs up to the beginning of the war were less than 50 per cent of the total capacity, these refineries were probably built to process the large supplies of crude oil Japan expected to ship in from the Indies once she had conquered them. As can be seen in the accompanying map, these refineries were situated on the main island of Honshu. Those along the northwest coast processed crude produced locally in Japan's only major oil producing areas around Akita and Nigata. Refineries along the southeast coast included the more modern plants and operated entirely on imported crudes.

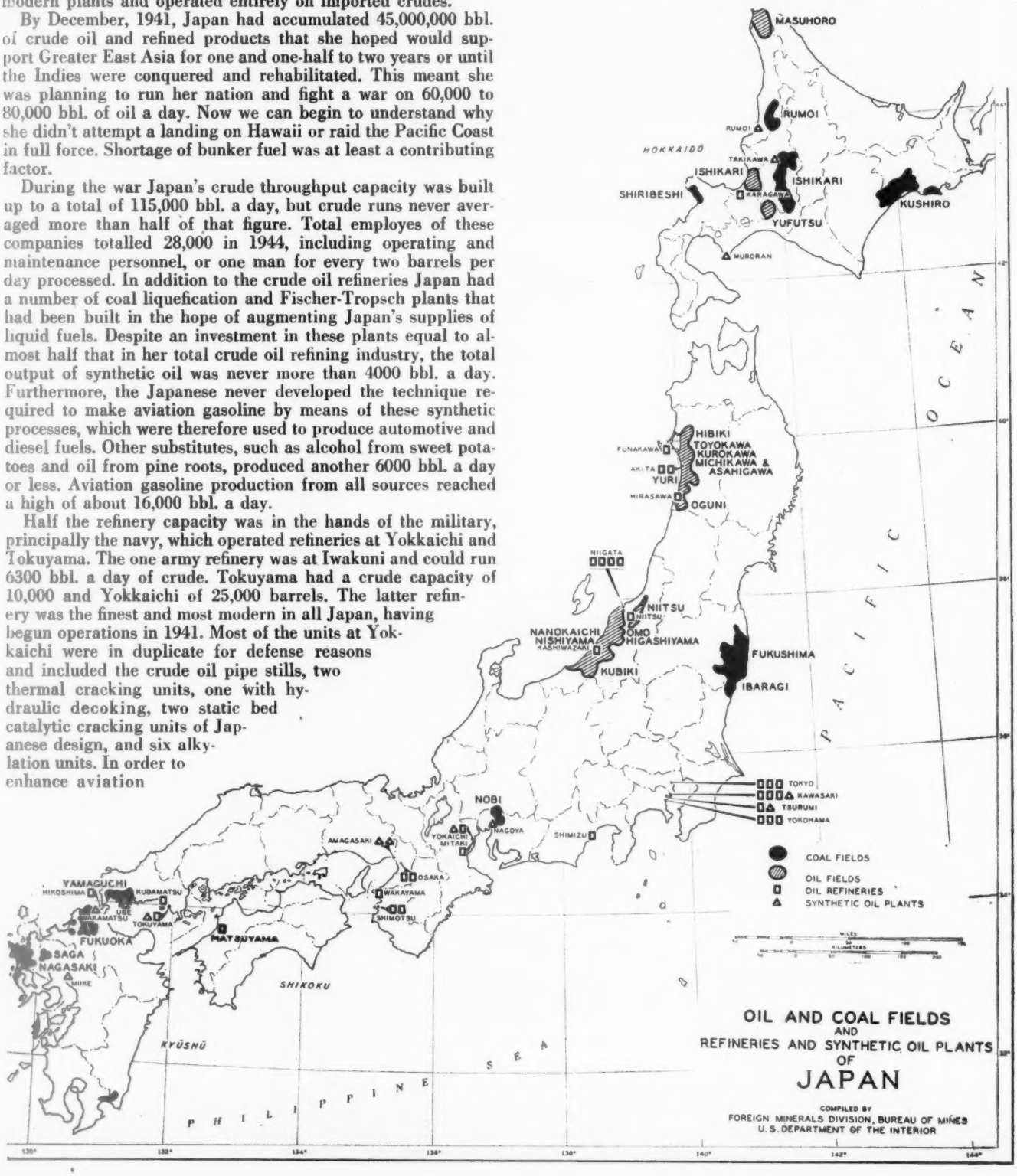
By December, 1941, Japan had accumulated 45,000,000 bbl. of crude oil and refined products that she hoped would support Greater East Asia for one and one-half to two years or until the Indies were conquered and rehabilitated. This meant she was planning to run her nation and fight a war on 60,000 to 80,000 bbl. of oil a day. Now we can begin to understand why she didn't attempt a landing on Hawaii or raid the Pacific Coast in full force. Shortage of bunker fuel was at least a contributing factor.

During the war Japan's crude throughput capacity was built up to a total of 115,000 bbl. a day, but crude runs never averaged more than half of that figure. Total employes of these companies totalled 28,000 in 1944, including operating and maintenance personnel, or one man for every two barrels per day processed. In addition to the crude oil refineries Japan had a number of coal liquefication and Fischer-Tropsch plants that had been built in the hope of augmenting Japan's supplies of liquid fuels. Despite an investment in these plants equal to almost half that in her total crude oil refining industry, the total output of synthetic oil was never more than 4000 bbl. a day. Furthermore, the Japanese never developed the technique required to make aviation gasoline by means of these synthetic processes, which were therefore used to produce automotive and diesel fuels. Other substitutes, such as alcohol from sweet potatoes and oil from pine roots, produced another 6000 bbl. a day or less. Aviation gasoline production from all sources reached a high of about 16,000 bbl. a day.

Half the refinery capacity was in the hands of the military, principally the navy, which operated refineries at Yokkaichi and Tokuyama. The one army refinery was at Iwakuni and could run 6300 bbl. a day of crude. Tokuyama had a crude capacity of 10,000 and Yokkaichi of 25,000 barrels. The latter refinery was the finest and most modern in all Japan, having begun operations in 1941. Most of the units at Yokkaichi were in duplicate for defense reasons and included the crude oil pipe stills, two thermal cracking units, one with hydraulic decoking, two static bed catalytic cracking units of Japanese design, and six alkylation units. In order to enhance aviation gasoline production there were two cracked gasoline hydrogenation units as well as equipment to produce hydrogen. There was also equipment for making lubricating oil.

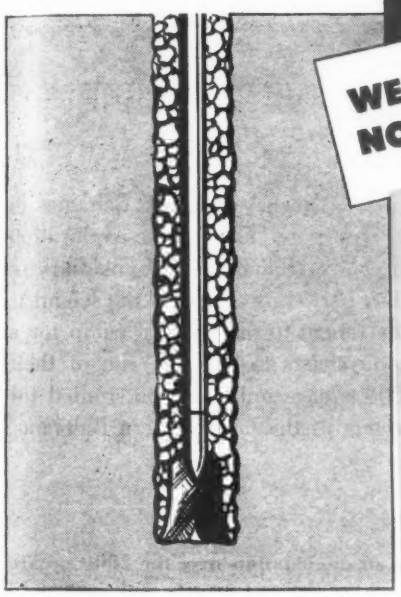
By December, 1944, most of Japan's refineries had ceased major operations because of crude shortages. Our submarine and aerial attacks on Japan's tankers had cut off all supplies from the Indies and had resulted in actual petroleum starvation.

Japan was so desperate for oil that she was making lube oil from her precious hoarded supply of rubber, was using millions of man-hours of precious labor in a vain attempt to make aviation gasoline out of the oil distilled out of pine roots, and was converting sweet potatoes and other starches badly needed for food into alcohol for training grade aviation fuel. Japan gambled against odds from the very beginning, and petroleum shortage was one obstacle she couldn't hurdle. ★★★



Smentox can save time and money on *your* well in *any* field

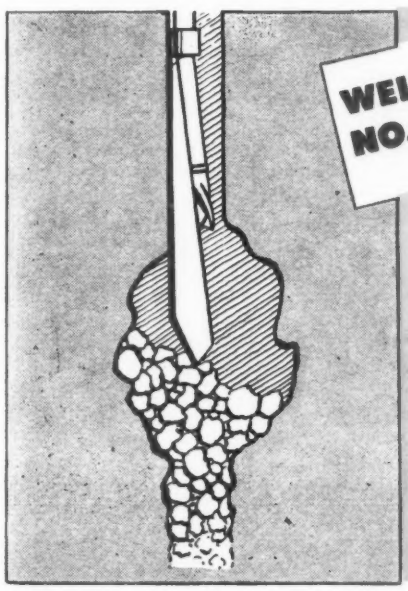
Two Rangely wells show effectiveness of SMENTOX in cutting rig time and mud loss by overcoming cement contamination.



WELL NO. 1

High-viscosity, cement-contaminated mud would not drop undesirable cuttings, causing them to be recirculated. Baroid field engineers recommended SMENTOX to reduce viscosity and AQUAGEL to condition the mud to continue drilling.

RESULT: By adding SMENTOX, operators reduced mud viscosity enough to drop undesirable solids, and, by adding AQUAGEL, they improved the mud characteristics even over those of the original uncontaminated mud.



WELL NO. 2

Operators could not reach bottom with a whipstock after drilling a cement plug because of a badly caving hole resulting from the use of a cement-contaminated high-water-loss mud. After cementing again, the operators planned to drill the new plug, discard the mud, clean the system, and mix new mud before running the whipstock. Baroid field engineers recommended saving the contaminated mud by using SMENTOX and AQUAGEL.

RESULT: A successful whipstock job after the drilling out of 100 feet of cement. SMENTOX and AQUAGEL saved the mud and many hours of rig time.

BAROID

SALES DIVISION

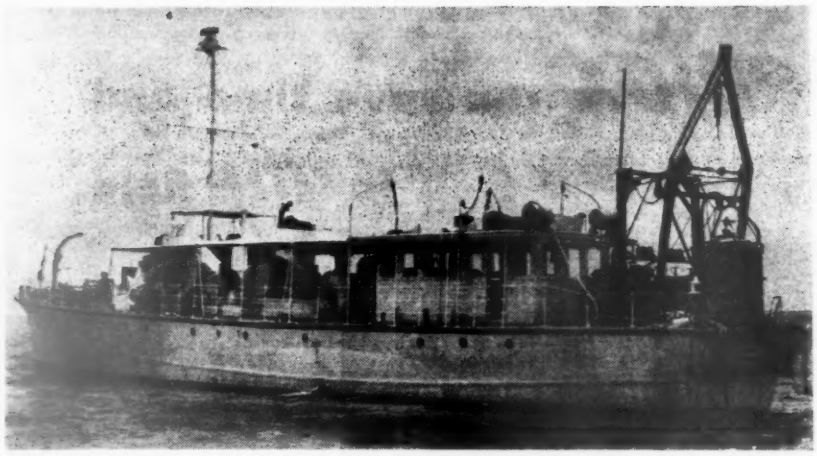
NATIONAL LEAD COMPANY

BAROID SALES OFFICES:

LOS ANGELES 12 • TULSA 3 • HOUSTON 2

PATENT LICENSES unrestricted as to sources of supply of materials, but on royalty bases, will be granted to responsible oil companies and others desiring to practice the subject matter of any and/or all of United States Patents Numbers 1,807,082; 1,991,637; 2,041,086; 2,044,758; 2,064,936; 2,094,316; 2,119,829; 2,214,366; 2,294,877; 2,304,256; 2,387,694; 2,393,165 and further improvements thereof. Applications for Licenses should be made to Los Angeles office.

BAROID PRODUCTS: ANHYDROX • AQUAGEL AQUAGEL CEMENT • BAROCO • BAROID FIBERTEX • IMPERMEX • JELFLAKE • MICATEX SMENTOX • STABILITE • ZEOGEL • TESTING EQUIPMENT • BAROID WELL LOGGING SERVICE



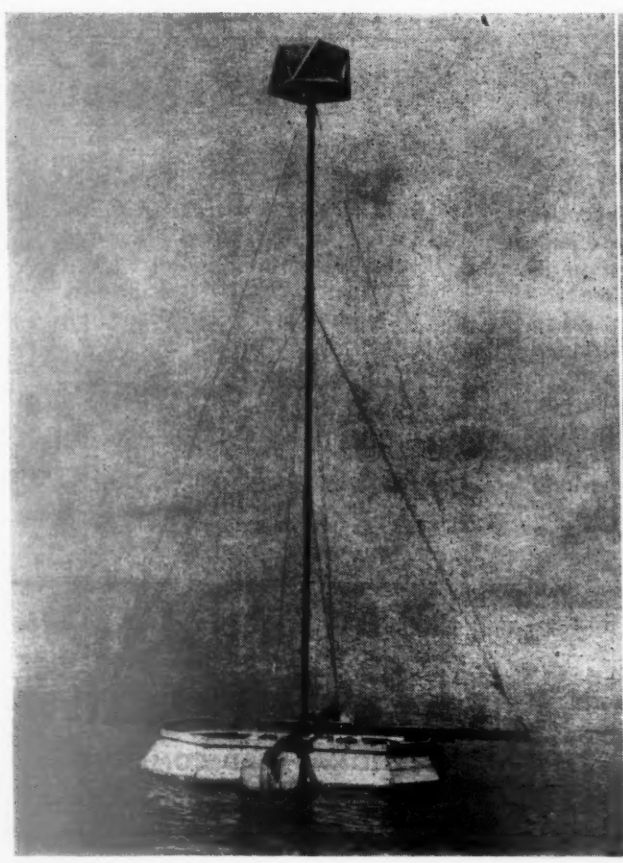
The 112-ft. Stanba, formerly of the Canadian Navy, is now the mother ship of the exploration party. Atop the mast on the left is the radar wave guide and at the stern rests a two-ton diving chamber in which technologists map the ocean bed. A supply ship brings fresh supplies to the mother ship from the camp at West End Island so that the party does not have to leave the Stanba for six weeks at a time. Between these periods they go to the island for rest.

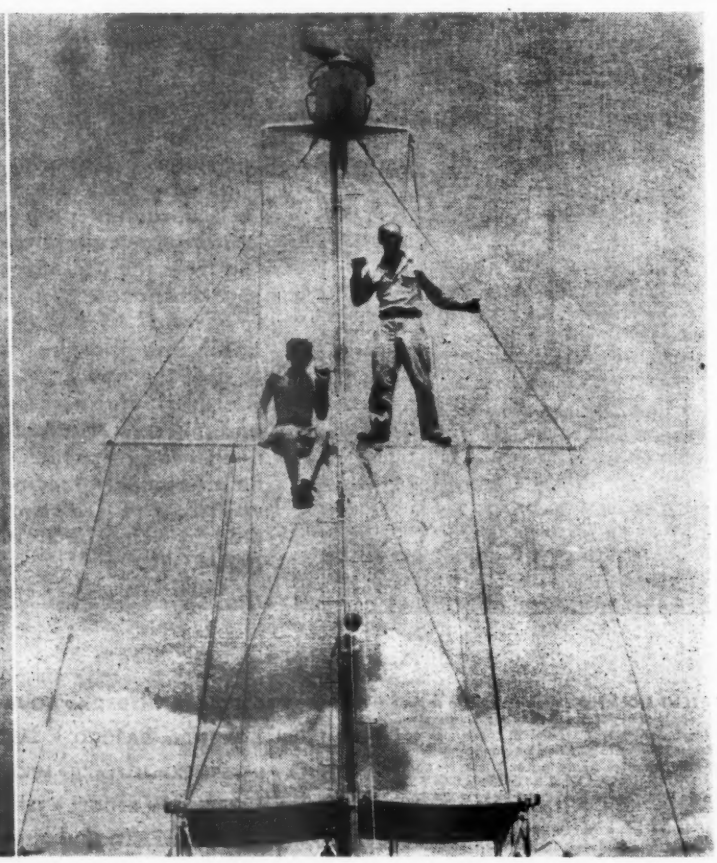
Exploring for oil in radar ship

PETROLEUM scientists are seeking oil in the ocean bed off the Bahamas in the first radar-equipped ship used for the purpose. The marine exploration is being conducted by Standard Oil Company (Bahamas), a subsidiary of Standard Oil Company (New Jersey). For period of six weeks the scientists and crew live aboard the ship, then they return to their island camp for a rest. The use of radar permits the geophysicists to plot the site of their tests with improved accuracy. Some 2000 square miles will be studied for indication of new oil deposits in the waters of the northwestern Bahamas.

PHOTOS COURTESY OF STANDARD OIL COMPANY (NEW JERSEY)

Radar targets like the one at left are set up at strategic points over the 2000 square miles in the Bahamas so that navigators can map the testing site with improved accuracy. Right is a closeup of the radar wave guide on the stern of the ship.





It's a case of TWO being much better than one

THE MARTIN DECKER 2-PEN SLUSH PUMP GAUGE RECORDER

Cement trucks work under widely varying conditions. Regardless of whether low pressure or high pressure is encountered, the cementer must be prepared to cope with any situation and still have records that tell a complete story. When a one-pen cement recorder is used, either range or accuracy is sacrificed. The new Martin-Decker Two-Pen Slush Pump Gauge Recorder solves this problem by furnishing in a single unit maximum capacity and a detailed record of pressures encountered and time required to put away the cement.

The capacity from 0 to 6,000 lbs. is automatically covered by one pressure element but two pen arms. Pressures from 0 to 2,000 lbs. are recorded by pen arm No. 1 which travels the entire width of the chart, thus providing a maximum detail for the low pressure cement job. When pressure in excess of 2,000 lbs. is encountered, the second pen arm moves forward and travels the entire width of the chart from 2,000 lb. to 6,000 lb., thus providing great detail in the higher pressure bracket. The action is fully automatic.

The Instrument is equipped with an automatic "stop" and "go" mechanism which sets it in operation by merely operating a lever so that the record begins on the chart the moment the cement job starts.

The Recorder is mounted in a steel box manifolded to an oil-filled, 6,000 lb. streamlined Indicating Gauge identical to those furnished with Martin-Decker Mud Pump Gauges.

The system is sealed at the Factory and equipped with adjustable Pulsation Damper and connected to a Martin-Decker alloy steel diaphragm protector by means of a high pressure steel reinforced flexible hose.

The instrument is designed for connection into the pump discharge manifold, with instrument panel mounted on the back of the cab or any convenient position desired by the operator.

M-D two pen Automatic Cement Pump Recorders can be furnished for pressures up to 15,000 lbs.

GREATER LEGIBILITY

The four-hour clock spreads the record out so that it is not crowded. Clear legibility and interpretation is further increased by the use of a chart-driving mechanism which turns faster than most recording devices and may be started and stopped at will by the operator. This device can be used for any type of pressure-recording information requiring great detail and wide range.

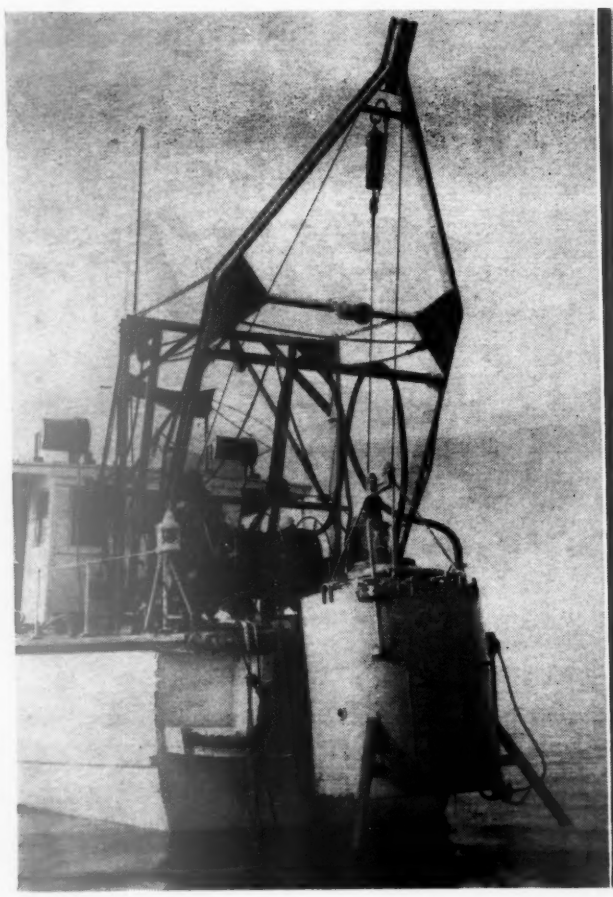
Write **for complete information!**

NONE OF THE WEIGHT INDICATOR

MARTIN DECKER CORP.

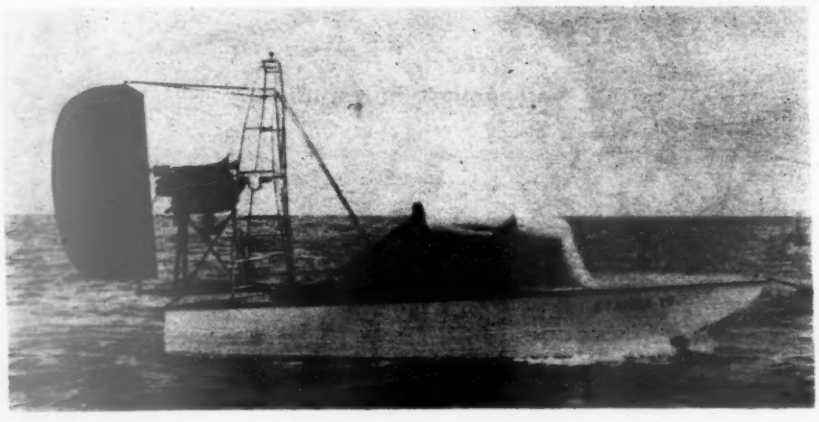
LONG BEACH, CALIFORNIA

SAN JOAQUIN VALLEY: T. J. CULLEN, BAKERSFIELD, CALIFORNIA
MID-CONTINENT DISTRIBUTOR: REED ROLLER BIT COMPANY, HOUSTON, TEXAS



A closeup of the two-ton diving chamber used in the search for oil in Bahamas waters. Inside the 6-ft.-high chamber a scientist operates a gravity meter to map the formations beneath the surface of the water. If geophysical reports are favorable over-water rigs will be erected later for drilling tests in the locations indicated.

The diving chamber is being prepared (above right) for lowering to the ocean bed. The operator carefully receives the gravity meter with which he measures the pull of gravity on the ocean bed and gets an indication of the type of rock and sand far below, indirectly providing information on the presence of oil below.



Above, Dr. R. J. Watson of Tulsa, Okla., manager of the exploration group, emerges from the diving chamber. With him are C. F. Sellers, left, in charge of the diving chamber and underwater gravity work, and J. Pollard of exploring group.

Bahaman waters are comparatively shallow and some places mapping of the ocean floor is conducted from a 22-ft. draft airboat. It is equipped with an airplane motor and rudder and can operate in water less than 6 in. deep, a great aid to explorers.

THE END

Aromatic hydrocarbons from petroleum

The Catarole Process

In 1945 a company called Petrocarbon Ltd. was formed to acquire from Dr. Ch. Weizmann the exclusive right to operate, under his patents, the Catarole process[1] in the United Kingdom and a great number of European and overseas countries. Catarole is a new process that makes possible the simultaneous production from an essentially non-aromatic charging stock (such as naphtha or gas oil) of the whole range of the aromatic hydrocarbons in substantially pure form, and of a gas mixture containing a high proportion of olefines. A pilot plant for the development of the Catarole process has been working since 1941, to study the influence of operating conditions and of different charging stocks.

Now it is announced that Petrocarbon Ltd. has made financial arrangements for the construction of a large commercial plant to operate the process on a full industrial scale. Construction and operation will be undertaken by a wholly owned subsidiary company, Petrochemicals Ltd., under the control of Petrocarbon Ltd. Initially, the new plant will have a capacity of 50,000 tons per year of charging stock, but provision has been made for expansion to deal with an input of up to 100,000 tons yearly. The most modern features of heat economy are to be incorporated, including the use of back pressure turbines for the generation of power.

For the erection of the new plant, a site of more than 700 acres has been purchased at Partington, near Manchester. Sanction has been granted by the planning authorities for the industrial development of a large part of this area. The land runs alongside the Manchester ship canal and thus has direct access to ocean-going vessels via Liverpool. Further, such a situation places the plant in the center of one of the most highly industrialized areas of England, with a large network of communcations for efficient internal distribution.

The site acquired is substantially larger than that needed solely for the Catarole plant. The intention is to provide space for the construction of plants by users of the basic raw materials that Petrochemicals will be producing. It is anticipated that Catarole will provide a nucleus around which other factories will be built, because it will provide many basic raw materials for the organic chemical industry.

The liquid reaction product from the Catarole process contains almost the complete range of high and low boiling aromatic hydrocarbons such as benzene, toluene, xylenes, ethylbenzene, styrene, alkyl-benzenes, naphthalene, alkyl-naphthalenes, anthracene, phenanthrene, fluorene, pyrene, and chrysene, all of which may be obtained in pure grades by azeotropic or fractional distillation and crystallization, with only slight additional chemical treatment. Syntheses using aromatic hydrocarbons and olefines as starting materials (such as, for instance, the production of styrene from ethylene and benzene, or of isopropyl-benzene from propylene and benzene), which have become an important feature of modern chemical industry, can be carried through economically and with great ease because both components are available on the same site. Another favorable feature of the Catarole process is its flexibility: Within certain limits it is possible to vary the proportions of the different chemicals produced to suit changing market requirements.

All products from the process are used in the manufacture of a wide range of commodities such as paints and varnishes, dye-stuffs, pharmaceutical products, photographic chemicals, synthetic fibers, synthetic rubbers, solvents, plastics, plasticizers, cosmetics, and insecticides. Also, some of the products have uses either as solvents, heat media, or blending stock for engine fuel. The need for expanding home production of these materials has been recognized by the Hydrocarbon Oil Duties Committee and has been repeatedly stated by a number of leading consumers in recent years.

TABLE 1. Aromatization of a naphthenic heavy naphtha.

Charge	
Specific gravity	0.798
Boiling range (5-95 per cent)	102.228°C.
Process temperature	680°C.
Space velocity	0.24
Liquid product	
Recovery, per cent by weight of charge	about 50%
Specific gravity	0.870
Composition, in per cent by weight of charge	
Boiling below benzene	1.8
Benzene	11.8
Toluene	10.7
Xylenes, ethylbenzene, styrene	*6.8
Alkylbenzenes (150-180°C.)	3.4
Above 180°C. (polycyclics)	15.4
Gaseous product	
Composition, in per cent by weight of charge	
Hydrogen	0.3
Methane	20.1
Ethane	6.7
Ethylene	7.8
Propane	1.8
Propylene	8.7
Butanes	1.3
Butenes and butadiene	†3.4

*This fraction contains on an average 20 per cent styrene, 10.8 per cent ethyl-benzene, 16.2 per cent o-xylene, 19.3 per cent m-xylene, and 24.7 per cent p-xylene.

†This fraction consists of 60 per cent n-butylenes, 30 per ent isobutylene, and 10 per cen tbutadiene.

The raw materials of the Catarole process are primarily naphtha and gas oil—both in abundant world supply, and which can either be imported or produced in refineries in Great Britain. So flexible is the process, however, that other starting materials may also be used such as shale oil or the coal oil from the low temperature carbonization of coal. The chemicals, solvents, spare parts, etc., required for the operation of the process are all available inside Great Britain.

The provision for capital required for this project including working capital, is about £1,800,000 and it is anticipated that the plant will be ready for operation in 1948. H. E. Charlton will be chief engineer in charge of construction. Thus, the research work begun in the laboratories some 10 or 12 years ago by Dr. Weizmann and his co-workers, chief among them being Dr. Ernst Bergmann, has been brought to a commercial stage by Dr. Franz Kind and an associated technical staff. Dr. Weizmann has agreed to act as head consultant to the undertaking and Dr. Bergmann will be technical consultant. It is intended that the research and development program of both Petrocarbon Ltd. and Petrochemicals Ltd. will be on a considerable scale, and Dr. H. Steiner will be in control of these activities.

The board of Petrocarbon Ltd. consists of: R. Ashton Hamlyn, O.B.E., F.C.A. (chairman), R. E. F. de Trafford, O.B.E., T. L. McC. Lonsdale, F. Kind, Ph.D. (Vind.) (managing director), G. Tugendhat, Ll.D. (Vind.), M.Sc. (Econ.) (managing director), Lt.-Gen. Sir. W. G. Lindsell, G.B.E., K.C.B., D.S.O., M.C., and M.A. Colefax.

The board of Petrochemicals consists of: H. Stuart Ebben, O.B.E. (chairman), Lt.-Col. Reginald Lindsay Benson, D.S.O., M.V.O., M.C., Dr. F. Kind (managing director), Dr. G. Tugendhat (managing director), and Lt.-Gen. Sir W. G. Lindsell, G.B.E., K.C.B., D.S.O., M.C. and M.A. Colefax.

Dr. Franz Kind and Dr. G. Tugendhat for the last ten years have been largely engaged on the building up the Manchester Oil Refinery group of companies, with which the Catarole project is closely connected.

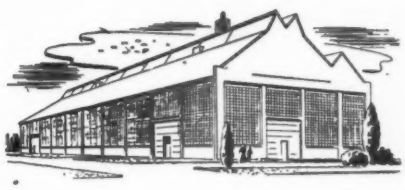
The London offices of the companies are at Adelaide House, London Bridge, London, E.C.4. The registered offices are at River Plate House, 12/13 South Place, E.C.2. The research laboratories are at Twining Road, Trafford Park, Manchester 17. Construction and devel-

ENGINEERING RESEARCH CENTER EXPANDED

Complete New Group of Pilot Plants Building at M. W. Kellogg's Development Laboratories

TODAY, newly constructed Kellogg plants are going into service to prove the feasibility and earning power of new chemical processing ideas.

At The M. W. Kellogg engineering laboratories and research center, Jersey City, N. J., these ultra-modern pilots are being utilized for detailed scientific studies of such unit processes as heat-exchange through entrained solids, as well as chemical process sequences in the various catalytic and solvent fields.



Goal of the talented staff of development engineers at the modernized laboratories is continued work of the kind for which M. W. Kellogg is noted . . .

For example, the Kellogg Fluid catalytic-cracking pilot plant was used in engineering more than 70% of the Fluid cat-cracking capacity of the oil refining industry. Kellogg pilots have disclosed a host of new facts for determination of profit potentials in the fields of solvent and ammonia manufacture, edible oil and fatty acid separation, and numerous others.

Representing an investment of over a million dollars, Kellogg pilots operate 24-hours-a-day on unit and sequence process developments.

THE M. W. KELLOGG COMPANY

Engineers and Economists to the Petroleum Refining Industry

New York, N. Y. • Jersey City, N. J. • Los Angeles, Cal. • Tulsa, Okla. • Houston, Texas • London, Eng.

This NEW WAY is a BETTER WAY of Welding REFINERY LINES and PIPE LINES

Weld with WEDGE Split CHILL RINGS

Refinery lines and pipe lines welded with the use of WEDGE Chill Rings with the patented SPLIT Feature are better because the joints are STRONGER. They are laid at lower cost with LIGHTER pipe . . . less labor. WEDGE Chill Rings RE-INFORCE pipe joints, making them

the strongest points of the line. Flexibility is an exclusive feature that adjusts each ring snugly to the unfinished inside surface of pipe. Alignment is simplified and speeded up. Welders work faster . . . and you are sure of 100% PENETRATION of the entire circumference. The NEW and BETTER way to join pipe is to weld it, using WEDGE Chill Rings. It will pay to investigate.

Write for Information

WEDGE PROTECTORS, INC.
3977 Jennings Road, Cleveland 9, Ohio

WEDGE Split CHILL RINGS SAVE MONEY

opment offices are at Clarendon House, 24 Clarendon Road, Eccles, Manchester.

● **Catarole process.** Some of the salient points of the Catarole process, of interest to the general technical reader, are reviewed briefly in this article.

During the last ten years it has become more and more evident that coal is no longer the only or even the main source of aromatic chemicals, and that it is possible to transform aliphatic hydrocarbons into aromatics of the same carbon number with the aid of catalysts such as alumina and promoters such as chromium oxide.[2]

For various reasons, however, only few individual aromatic hydrocarbons have become available by working that process on a technical scale.

Coal, on the other hand, makes available the whole range of aromatics at once, but the extent to which coal tar can be produced, obviously depends on the extent to which the coke, forming the main product of the process, can be commercially utilized.

Further research into the conversion of aliphatic hydrocarbons into aromatics has shown that it is possible to treat any non-aromatic charging stock in such a manner that the whole range of aromatic hydrocarbons is obtained. Petroleum is, therefore, no longer second to coal as a source of aromatic hydrocarbons. Also, the choice of special charging stocks or fractions and of the processing conditions makes it possible to vary the quantitative composition of the resulting aromatized product.

If petroleum is passed through a packed tube at atmospheric pressure at 630-680° C. and a velocity of 0.05-0.5 liters per hour and liter catalyst volume, the resultant liquid has an aromaticity of at least 95 per cent. In addition valuable gaseous products are formed.

The use of metals (such as copper) as packing materials reduces the temperature required for substantial aromatization to 630-680° C. and also the extent to which carbon formation takes place. These two factors, combined with the purity of the products make the process economical.

Table I lists the products obtained by aromatization of a naphthenic heavy naphtha, both the liquids (and solids) and the gases. The high degree of unsaturation of the gaseous products is noticeable, and it makes these gases valuable starting materials for synthesis.

The reaction product is largely free from sulphur, nitrogen, and oxygen compounds, even if such were present in the charging stock. This is one reason for the already mentioned ease with which the products can be isolated by fractional distillation.

Generally speaking the process discussed is a method of producing pure chemicals, rather than a new cracking process.

It appears appropriate to comment on the composition of the polycyclic fraction of the reaction product, as the process to which this report refers has succeeded for the first time in converting petroleum into the whole range of such substances. They are of interest to the manufacturers of dyestuffs, pharmaceuticals, and other organic chemicals.

The following list names some of the constituents of this polycyclic fraction:

naphthalene
α-methyl-naphthalene
β-methyl-naphthalene
1.6-dimethyl-naphthalene
2.6-dimethyl-naphthalene
1.2-dimethyl-naphthalene
1.7-dimethyl-naphthalene
1.2.5-trimethyl-napthalene
1.2.6-trimethyl-naphthalene
fluorene
acenaphthene
biphenyl
phenanthrene
anthracene
1-methyl-anthracene
2-methyl-anthracene
2.7-dimethyl-anthracene
1.2-benzanthracene
1.2-benzfluorene
2.3-benzfluorene
chrysene
pyrene
3.4-benzpyrene
1.2.7.8-dibenzo-chrysene

It is interesting to note that the only side-chain appearing in these substances is the methyl group. This is undoubtedly due to the fact that longer side-chains are broken off (in form of the corresponding olefines) at the process temperature. In the alkyl-benzenes fractions, too, polymethylated benzenes predominate. They are, however, accompanied by such substances in which the unsaturated nature of the side-chain increases the stability of the molecule (resonance stabilization), such as styrene, β-methyl-styrene and indene.

The relatively high percentage of styrene, ethylbenzene, and pyrene is interesting; it is believed that this fact will shed some light on the reaction mechanism.

The gases, as already pointed out, are highly unsaturated. All the syntheses starting from these olefines (glycol and glycol derivatives, isopropyl alcohol, acetone, etc.) become thus possible.

The industrial success of the whole process depends to a large extent on the proper utilization of the olefinic gases.

● **Summary.** The practical importance of the process lies mainly in the fact that it produces simultaneously a wide range of those aromatic and aliphatic hydrocarbons that form the basis of the modern production of organic chemicals, and that it produces them in a state of high purity. Thus, the process may well be able to supplement the coal-tar industry, which is, and is likely to remain, the mainstay of British chemical industry. ★★★

1. Weizmann and co-workers, British Patents 552, 216; 574, 963; 574, 973; 575, 383; 575, 766; 575, 768; 575, 769, 575, 771.
2. See e.g. Moldavsky and Kamusher, *Chem. Centralblatt*, 1936, 112339, 6713
Moldavsky, Besprosvannaya, Kamusher and Kobilskaya, *Chem. Centralblatt* 1938, II 1023.
Grosse, Morrell and Mattox, *Oil and Gas Journal*, November 24, 1939.
U.S.A. Patents 2,124,536; 2,124,537; 2,124,183-6.
Taylor & Turkevitch, *Trans. Faraday Soc. 35*, 921 (1939).

Which Alloy?

TUBE-TURN quality-controlled Welding Fittings and Flanges are available in a wide range of metals and sizes to meet virtually every piping need. Practical production and application experience has dictated the engineered development of every fitting design. The selection of each alloy was made only after careful research and close cooperation with alert piping engineers all over the country whose daily problem is to cope with specific conditions of heat, pressure, flow and corrosive attack.

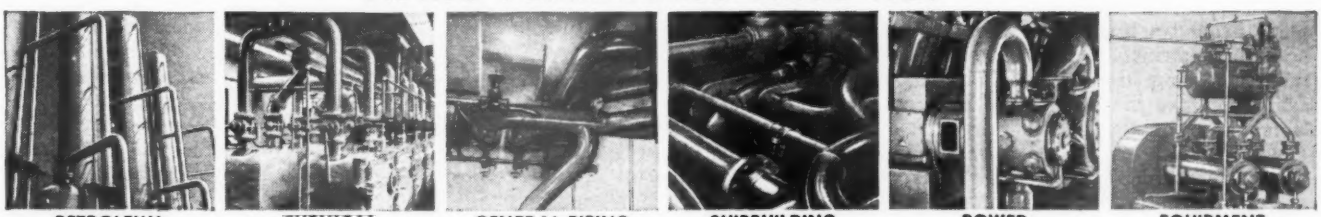
Not just another fitting . . . but one which meets, in every way, the rigid requirements of planned, long-lived systems . . . systems in which every component part plays an important role.

Tube-Turn engineers are ready to work with you and give you the benefit of their wide background of experience in the use and production of welding fittings in all these alloys. For piping permanence in alloy systems, be sure the Welding Fittings and Flanges are trade-marked Tube-Turn.

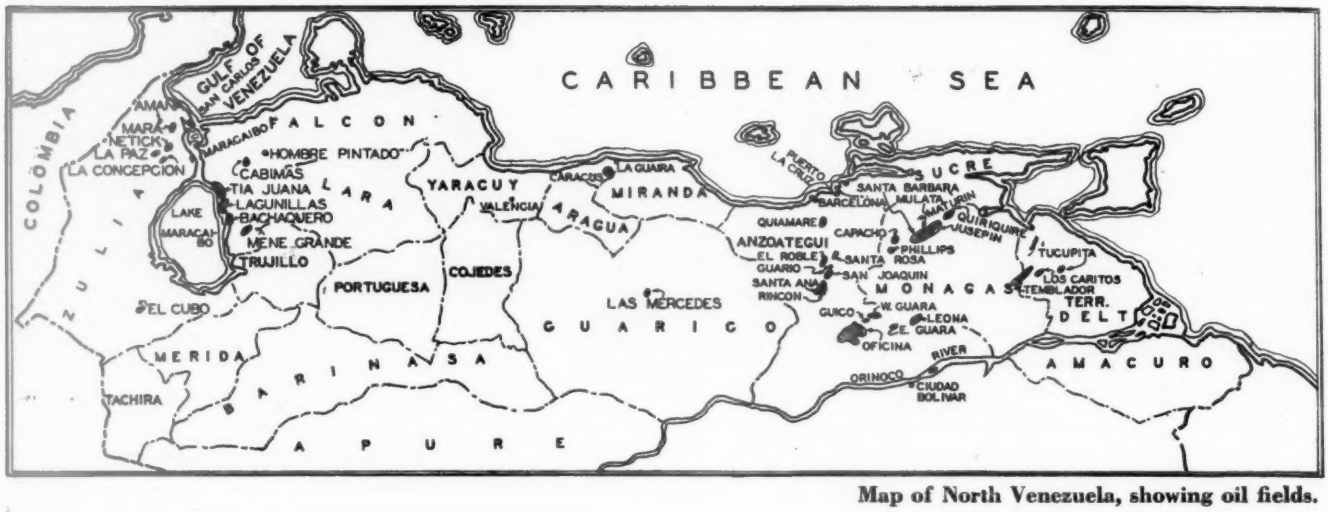
TUBE TURNS (Inc.) Louisville 1, Kentucky. District Offices: New York, Washington, D. C., Philadelphia, Pittsburgh, Cleveland, Detroit, Chicago, Houston San Francisco, Los Angeles.

TUBE-TURN TRADE MARK **tt** *Welding Fittings and Flanges*

PIPING PERMANENCE SINCE 1927



PETROLEUM | CHEMICAL | GENERAL PIPING | SHIPBUILDING | POWER | EQUIPMENT



Map of North Venezuela, showing oil fields.

Petroleum highlights in Venezuela

By **HARRY H. POWER,** Department of Petroleum Engineering, University of Texas

EXCLUSIVE

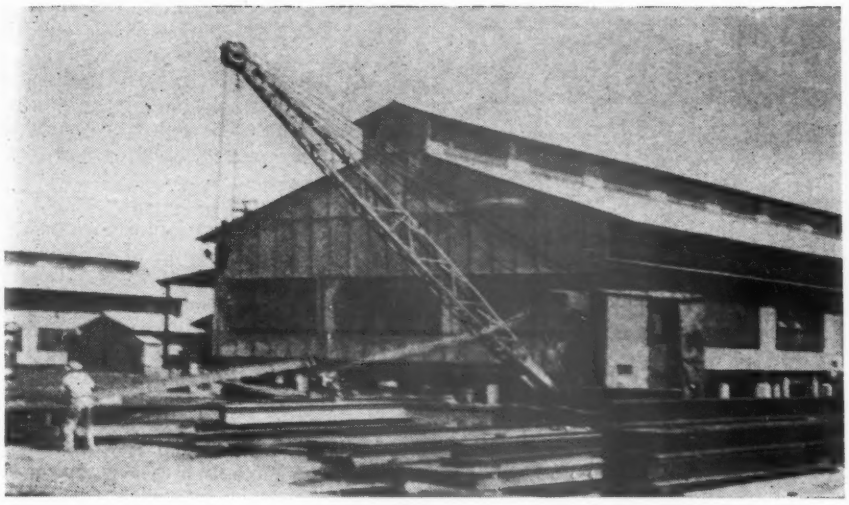
With your permission I will invite you to accompany me on a trip to Central America, the Canal Zone, Colombia, and Venezuela. Let us take the plane or the train down to New Orleans, leave the Pan-American Airport on a fast, modern clipper along about four o'clock in the afternoon, and proceed over the blue waters of the Gulf of Mexico to Merida, Mexico, on the Yucatan peninsula. The trip on the clipper plane is exceedingly smooth, and after a few minutes we overcome our old apprehensions concerning flight over water and lose ourselves in conversation with other North Americans, as well as some of our friends from Mexico, Colombia, and Peru who are returning to their respective countries. We arrive in Merida about seven in the evening and go to the emigration desk to show our transport cards and passports. We enjoy a supper on the deck of the airport station overlooking the field, and embark on a Douglas DC-3 plane for Guatemala City at seven-thirty in the evening. This part of the country is both flat and mountainous. Rain and local squalls toss our plane around a bit, but we eventually land in Guatemala City at about ten-thirty. Passing through the customs again, we take the bus for the Palace Hotel and retire about eleven-thirty.

We are awakened in the morning at three after a short, fitful night's rest and have breakfast at four. At five we embark again for Panama. On taking off, we marvel at the splendors of the early morning sun against the lofty peaks of Quatemala, El Salvador, and Honduras. Many extinct volcanoes are passed, and later on in the morning we are gratified to see one that is recorded to be active, with clouds of steam, vapors, and gases above its crater. Finally passing into Nicaragua, we continue our flight at between 12,000 and 15,000 ft. with mountain ranges on each side, and eventually pass along the shores of the famous Lake Nicaragua, the largest lake in Central America. Stopping at Managua for a few minutes, we take off again, flying above Costa Rica, and eventually arrive in Ancon on the Pacific side of the Canal Zone at two p.m., and spend the afternoon sight-seeing and note the large number of soldiers, sailors, people in diplomatic circles, nationals, and others. We finally retire in the old but comfortable Tivoli Hotel and awaken early next morning to leave by Pan-American plane again at seven a.m.

We find ourselves cutting across the Caribbean Sea for Barranquilla, Colombia. From Barranquilla we fly directly over the Andes through mountainous scenery in all its majestic splendor and between lofty, snow-covered peaks, reaching from 15,000 to 20,000 ft. We are fortunate that the route is over the divide on this particular trip, because, when the weather does not permit, an alternate route several hundred miles longer must be made by sea. We finally touch in at Maracaibo, the famous oil city of Venezuela, and then proceed up along the northern coast to Coro and La Guaira, the brilliant harbor where the Andes come right down to the water's edge. The trip over the high mountains has affected our ears somewhat, and it is difficult to hear. However, we must go through the customs, so we swallow hard and try to equalize the pressure on our ear drums again.

Finally, all personal belongings checked at the desk and our passports examined, we are loaded onto a bus to begin the long, winding 22-mile ride over the Venezuelan Andes into Caracas. We consider with much interest the many curves on the road before us that winds several thousand feet into the air and then brings us down into the valley where the capital city of Caracas nestles 3000 ft. above sea level. Although the temperature around La Guaira is warm and the humidity high, the climb up the road with its 300 curves soon brings us to a more agreeable climate. It feels more like the resort weather of Colorado during the summer. At one place along the winding way we note with interest a monument by the roadside. It is some 20 ft. in height and is meant as a warning to drivers. Inscribed on a copper plate at the base of the marker are the words in Spanish, "'Slowly One Goes Far." A wrecked automobile is set astride the monument with bent fenders and crushed body, which give significant realism to the warning.

We learn that this road connects with



A portion of the industrial section, San Tome—Mene Grande Oil Company.

the Trans-Andean highway, which is the longest and best known in Venezuela. From Caracas this highway proceeds westward for 800 miles across mountains 16,000 ft. high and over valleys, pastures, farms, and jungles. The road finally crosses the Tichira River at the border and on to Bogota and other Colombian cities amidst scenes known so intimately by Simon Bolivar, the Liberator, at the turn of the Nineteenth Century. We find further that tourists travel this road from La Guaira and proceed 130 miles to Caracas, Maracay, Valencia, and down to Puerto Cabello. Here they re-embark on the ships they left two days before at La Guiara.

At the top of the divide between La Guaira and Caracas we disembark because of a tire failure and stand around in the Andean rain. Our enthusiasm temporarily "dampened" we are eventually conveyed to the downtown station of Pan-American in Caracas. From this point we are loaded into a taxi of the Avila Hotel, which makes scheduled trips to the center of the city and caters to foreigners such as ourselves. We find the Avila to be a most up-to-date and modern hotel. After a warm bath and clean clothes we look with satisfaction from the balcony over the wide expanse of the valley in which Caracas is situated between the two parallel ranges of the Caribbean Cordilleras. We find that the taxis of the Avila Hotel are particularly useful to foreigners like ourselves, since they are usually found anywhere downtown. Caracas streets may be mastered by a simple direction to the driver to proceed to the Avila Hotel from which point reorientation makes it possible for the newcomer to "find his bearings" and proceed accordingly.

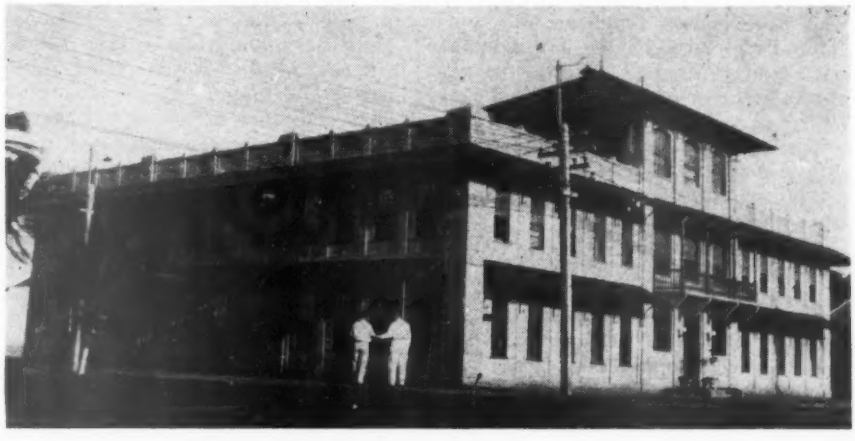
Except in the very latest additions to Caracas, we find that the streets are not named and the houses are not numbered. Instead, the various street intersections or corners are given distinctive names, and the houses in the block are given names instead of the usual numbers that is the custom in the United States. This situation is well implanted in the minds of taxi drivers, but not in our consciousness. So we give the Avila cabmen our blessings. The perplexities of the Caracas streets may be overcome by the instructions, "Avila, por favor."

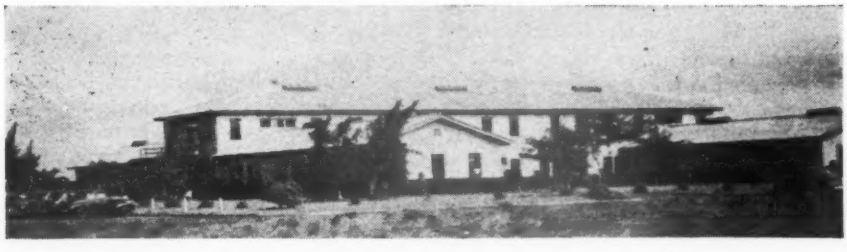
During our stay in Caracas, we visit the Ciudad Universiteria. This is a branch of the National University. A new and beautiful location has been picked on the outskirts of Caracas for this large enterprise. Dr. Santiago Vera I., Dean of the Engineering School, invites us to dine at a suburban restaurant, and we spend several hours talking over petroleum engineering and other educational matters.

Several days later, Dr. Matorano, who is also a member of the petroleum division of the Government Petroleum Administration or Fomento, conducts us to the head offices and introduces us to Dr. Luis Herrera F., Director of the Petroleum Department.

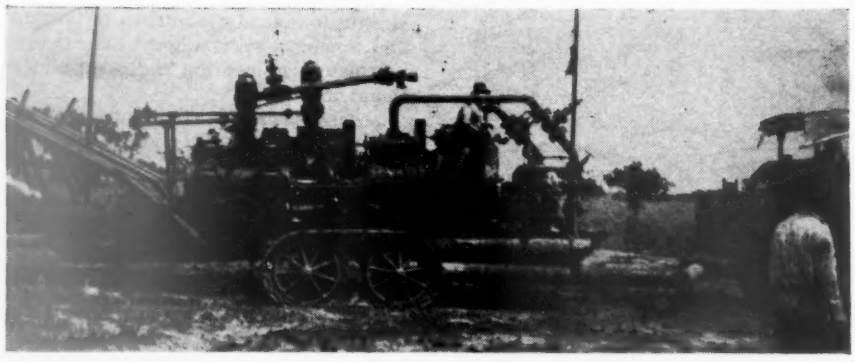
After several days spent at Mene Grande headquarters in Caracas, plans are made to proceed to company operations in Eastern Venezuela. We drive over the mountains again down to La Guaira in the company of several company officials and embark at the Maiquetia Airport on the company plane. We fly along the coastline at an elevation of about 10,000 ft. parallel to the coast mountain ranges until we finally reach a point near Barcelona from which we turn southward in the general direction of Ciudad Bolivar. We find that the mountainous country has changed to a vast level country known as the Llanos country of Eastern Venezuela. It is approximately 700 ft. above sea level and grows tough, unpalatable grass and an occasional Chappara tree. At two o'clock in the afternoon we arrive at San Tomé, the center of our company's oil operations in Eastern Venezuela. We find that the airplanes, the hangars, the radio station, in fact, everything connected with aerial transportation, is owned and operated by the company.

And so, from San Tomé we are to visit the oil fields at Eastern Venezuela and make many trips north, south, east, and west to study the problems characteristic of that area. We are conducted to the official guest house of the company and then make a little tour of the company owned village. We find that the houses are quite modern with every convenience,





Venezuelan division headquarters, Mene Grande Oil Company, in the city of Maracarbo, above, and in San Tome, left.



Transporting drilling equipment in Llanos country of Eastern Venezuela.

Tug and harbor, Mene Grande Oil Company's loading terminal, Puerto la Cruz.

including electric lights, hot and cold water, sewage disposal, pretty lawns, and shrubbery; in short, all the features that go to make homes complete. The manager takes us over to see some of the workmen's houses, which are very substantial and sanitary. We dine later at the company mess hall. All single people at camp take their meals at the common mess hall where National waiters serve well-cooked meals, but here is where a little knowledge of Spanish comes in handy. We practice our first Spanish from the menus.

The next day we note further the completeness of the village with its shop, an industrial section, the warehouses (one warehouse stocks more than 30,000 automobile and tractor repair parts), the commissary, the public schools, the hospital, and the division headquarters offices.

We find that the company runs the commissary and that most of the help employed is National, but that the problem of procuring adequate supplies during the war years was a real and sometimes difficult one. However, most of the more stable items of food are now available.

Several days later we drive over to the town of El Tigre. The town is spread out on each side of the main highway, and the houses are for the most part constructed of bamboo over which adobe is plastered and painted various vivid colors with an emphasis on blue. Although the oil companies supply housing to most of their workmen and employees in general, some of them prefer to commute back and forth from these National villages. We are also interested in visiting several of the stores and note that cloth and other necessities are of excellent quality but somewhat expensive.

The next afternoon we go swimming at the official swimming hole situated about three miles from San Tomé. Most of the flowing water on the mesa comes from springs that may be located usually by a grove of palm trees and other surface indications of these llanos oases. The water is quite pure and there is no fear of contracting or obtaining diseases from drinking it or swimming therein. We find that the stream has been dammed above and below the swimming hole to prevent various vicious fishes from entering. For instance, the Caribe are small fish with sharp, serrated teeth that attack people in the water viciously, and sometimes with serious results. The dams at either end of the pool also prevent electric eels from entering, and, in one instance, a boa constrictor was killed in the immediate vicinity. However, the swimming activities continue, fortifying ourselves with the knowledge that the frequent dynamiting of the pool presumably kills the predatory inhabitants of such places. While swimming in the shade of the palm trees we also note with interest the flocks of parrots over the area, numbering up to 100 or more, which fly by in one direction and then come back again. Why the reverses only the parrots know.

Let us go out to the club some evening and see a movie. The outdoor dancing floor has been provided with seats and the whole town gathers, for the movies bring old home ties closer. In the news reel we note with amazement that the President of the United States appears to be addressing us in Spanish. Of course, this is not actually the case, for his English words are merely reproduced in Spanish. We find, however, that most North American movies are presented in English and are provided with Spanish sub-titles, which are read and not spoken. English speech with the Spanish subtitles appears to be preferred by expatriates and Nationals alike.

The next day we drive to the San Joaquin Camp of the Creole Petroleum Corporation. The road is an excellent asphalt-surfaced highway constructed jointly by Mene Grande and Creole companies. It runs from Puerto La Cruz, the ocean terminal on the Caribbean Sea, southward past the San Joaquin area to El Tigre village and San Tomé, approximately 175 kilometers from the seaboard, and from there native roads that are not much more than mere tracks across the llanos plains, continue to the Orinoco River and Ciudad Bolivar. Fifty-two kilometer south of Puerto La Cruz, another fine asphalt highway constructed by Mene Grande and Creole, branches off to the east through Santa Barbara and Jusepin and on to Caripito.

The construction of these two roads cost Mene Grande and Creole more than $7,500,0000 and hundreds of thousands of dollars more are spent each year on maintenance. In addition, a number of oil companies operating in Eastern and Central Venezuela have joined together to share the cost of a highway to run from the Puerto La Cruz ocean terminal some 300 kilometers southwest to the interior of the State of Guarico, where the various companies are carrying on exploration and initial development work. The construction of this new road is now underway.

Road construction costs are particularly high, for the country off the mesa becomes quite dense with tropical foliage and bushes. Ticks are particularly obnoxious to both humans and animals alike, especially in the dry season. Road construction through the coastal range and the swampy valleys between the ranges is very costly.

Referring back to San Joaquin, we meet the superintendent and his petroleum engineers and inspect the camp where the houses are built on high columns, Panama style. This camp serves the San Joaquin field, and also the El Roble field a little to the north. The San Joaquin field is producing currently

about 11,000 bbl. daily of 43-deg. gravity wax crude from wells completed dually at a depth of about 8000 ft. The El Roble field is producing some 4000 bbl. daily of high gravity wax oil. The gravity of the crude when this field was first developed was about 45 deg., but it has since increased to 55 deg. and a stabilization plant has been proposed

Leaving San Joaquin, we go to the Mene Grande operated Santa Rosa area to the east where the cook prepares a most excellent meal. We inspect the company constructed houses for the laborers, noting the range of coastal mountains to the north, and come to the conclusion that drilling under such an environment is not bad at all. From Santa Rosa, we drive northward about 100 kilometers, passing over the Andean coastal range, and on to the Puerto La Cruz terminal where the oil tankers are loaded and supplies are received. There we rest in the well-equipped lodge of the company camp situated along the beautiful shore line of the Caribbean Sea.

On a week-end we go fishing out among the many islands that help to make Puerto La Cruz particularly safe against the prevailing northeast trade winds. Using regular deep sea trolling tackle we succeed in catching several tarpon, a vicious long-toothed barracuda, several yellow-tails, a kingfish, a gar, and several mackerel.

On another trip we visit the wildcat well La Ceiba C. B. No. 1 about 70 kms. on the way to Santa Barbara. Although this is a wildcat camp, everything is clean and orderly. An attractive grove of papaya trees surrounds the camp house of the usual tropical construction. In a cage the drillers show us a number of brightly colored parrots and parakeets and other birds characteristic of the country.

When we drive to the Santa Barbara camp, second in size to San Tomé insofar as company operations are concerned, and meet the superintendent, several of the petroleum engineers, and also superintendents and engineers of other operators in this area. We find that the various company division headquarters are quite substantial and would be a credit to any oil community anywhere.

From Santa Barbara we drive on to the old city of Maturin, and from thence to the northeast on a winding road through dense jungles to Caripito, the official Eastern Venezuela headquarters camp of the Creole Petroleum Corporation. Here in the late evening we obtain a beautiful view of the Cordillera range of the coastal mountains immediately to the north, and the jungles of the San Juan River on the south and east where we stop to look at tropical birds or even a monkey. Not only is Caripito the headquarters for production operations, but also for a very large refinery operate by Creole. The production superintendent conducts us to the up-to-date guest house equipped with short wave radio and all modern conveniences. Later we go to the company mess hall and have a most excellent dinner.

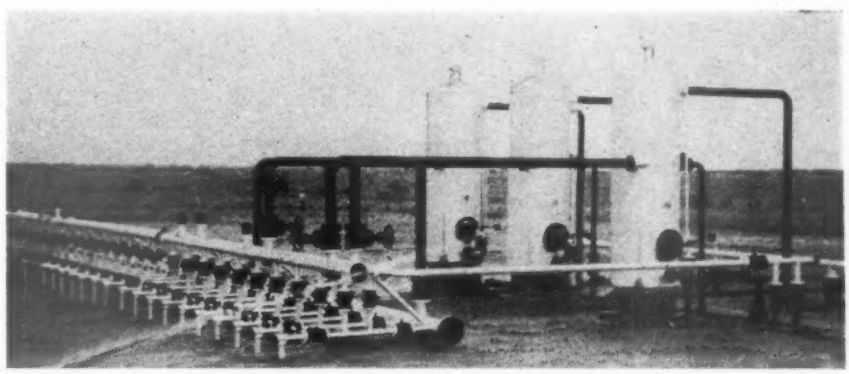
The next morning we have an opportunity to see the other good features of the Caripito area. For instance, we note with interest the well constructed swimming pool; the golf course; rolling, well landscaped topography; the nicely constructed bungalows for the company personnel; flowering shrubbery; tropical fruit trees; the new church; the hospital on the hill; the big commissary; the clubhouse, and the modern office building. After conferring with the Creole superintendent and engineers, we leave about 11:30 and return to Maturin for lunch. At night we rest at the Santa Barbara camp and the next morning we inspect several locations where complete hillsides are scraped away for suitable well locations. We also inspect a water station, a brick plant, the preliminary construction work for a pressure maintenance plant, a new diesel rotary outfit capable of drilling to 12,000 ft., and a "blow-case" for pumping oil from the central gathering system to storage. Arriving at Santa Barbara again we have a joint session with the geologists and petroleum engineers on problems pertinent to the area.

Finally, the day of departure for Western Venezuela arrives. A National company employe drives us to Barcelona where we take the Avensa (Venezuelan) plane for Maracaibo. The first part of the trip is to La Guaira, most of the ride being over the Caribbean Sea. As we do not have passage all the way to Maracaibo, we are "off-loaded," or what amounts to the same thing in this country—"bumped," and we engage a taxi to convey us to the Miramar Hotel for the night. The Miramar, facing the Caribbean Sea, is one of the old hotels erected by a former President of Venezuela and proves to be both interesting and restful.

We arise early the next morning and leave the Miramar by taxi for the airport, and resume our trip by Pan-American plane from La Guaira to Maracaibo. Arriving at our destination at noon, we drive to the ferry and cross Lake Maracaibo to the eastern shore, where we meet the various production superintendents and district engineers, visiting the Cabimas and Laganillas fields and also inspecting the Creole plant for casting concrete piling.

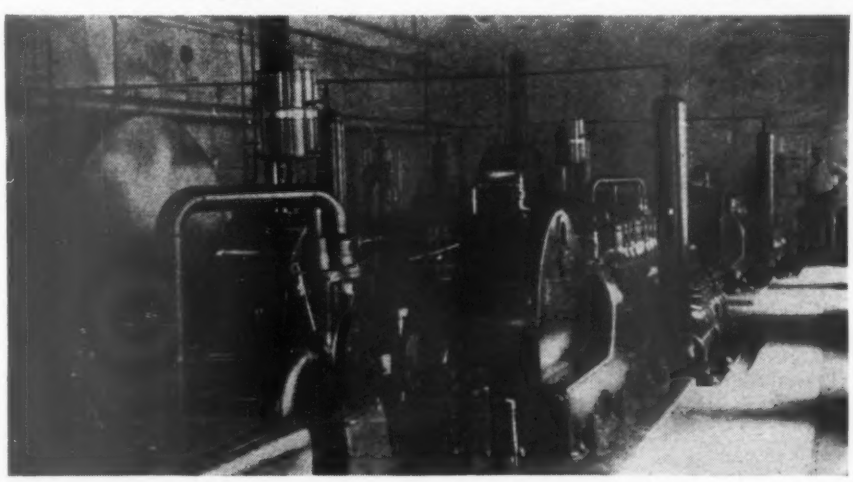
The next day we drive around the Las Morochas camp and see the Pueblo Viejo village which has been purchased by the company for drilling sites. In the afternoon we take the company launch out to see water operations, including a compressor plant and a clean-out string on a barge. We return to the Las Morochas camp and take the station wagon to the ferry and thence across the lake into Maracaibo on the western shore.

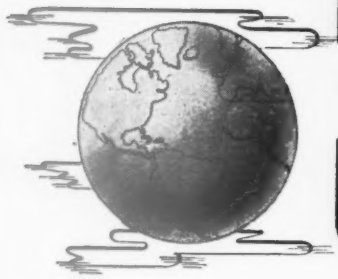
Arising early next morning and in the company of the district geologist we drive along the lake to the Eocene outcrop on the north, and then west to the



Central gathering station of Mene Grande Oil Company.

Mene Grande pipe line station, Eastern Venezuela, showing 650 hp. units.

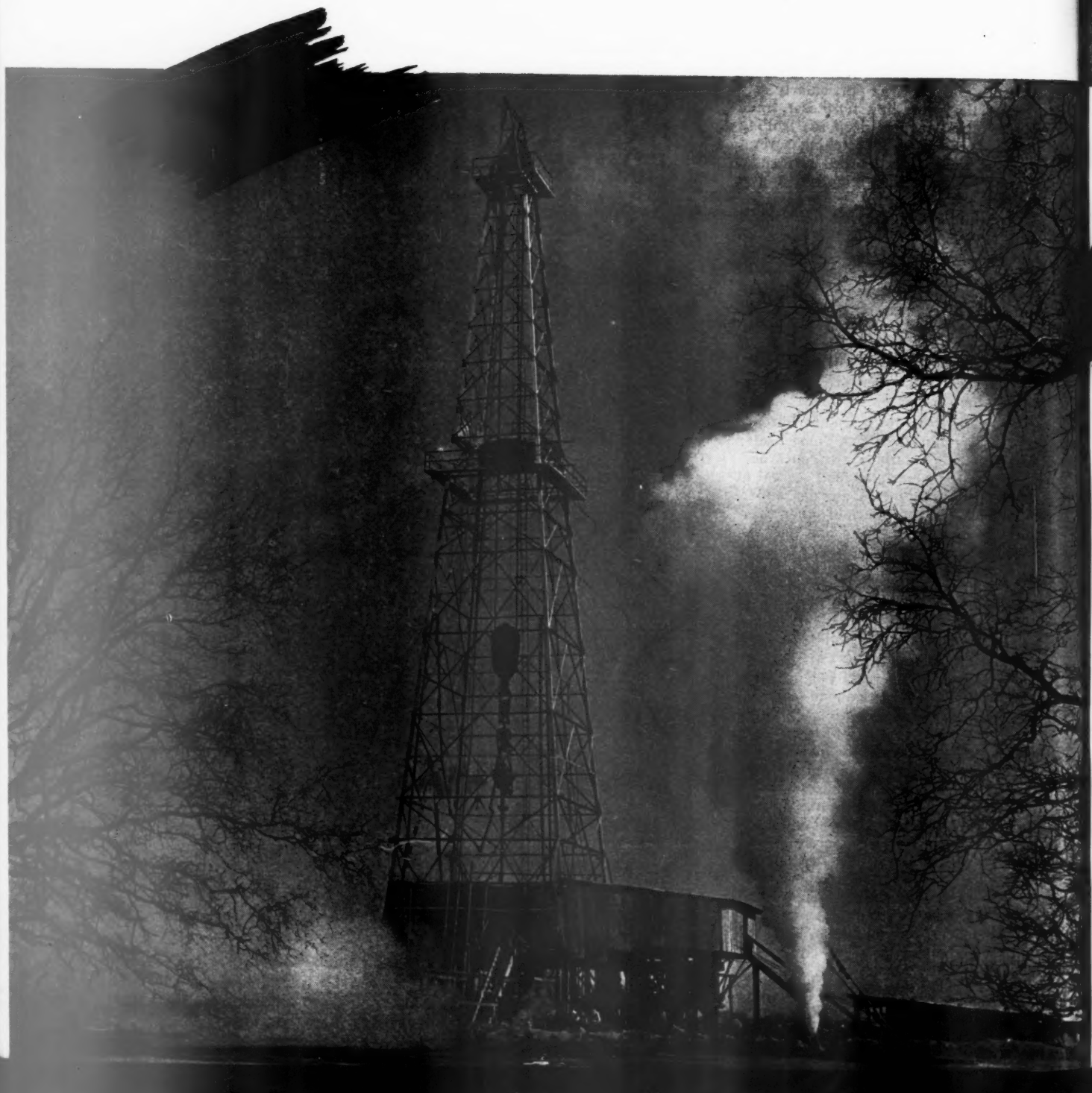


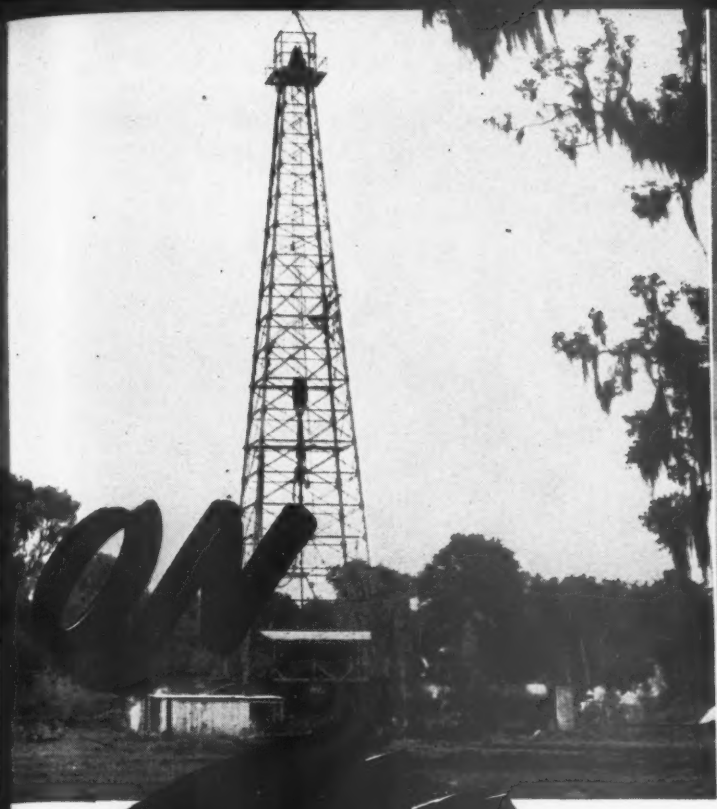


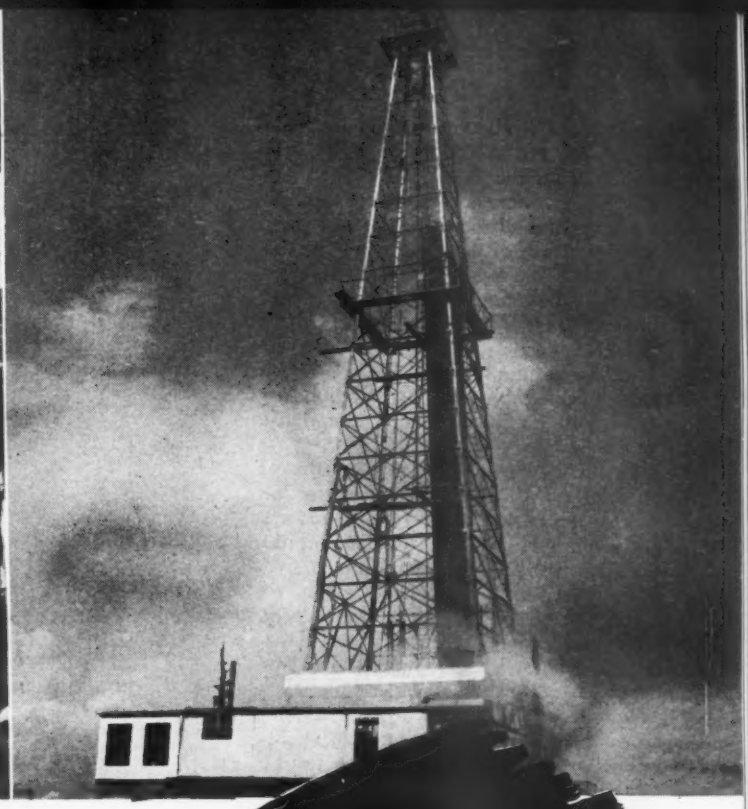
3 WORLD RECORD WELLS

all drilled and / or completed with

CAMERON IR







Pictured here are two familiar manifolds wherever well pressures are a menace to safe drilling and completion operations: a Cameron Drilling Control Hook-up and a Cameron Christmas tree. Most wells drilled below 10,000 feet are protected with Cameron Pressure-Operated Drilling Control Units, and more and more operators are accepting Cameron Safety Christmas Trees as the ultimate in dependable completion control equipment.

The Cameron drilling control hook-up presented above consists of two Cameron Type "QRC" (quick ram change) Pressure-Operated Blowout Preventers flanged above and below a Cameron Drilling Spool with a Cameron Type "DV" Pressure-Operatd Gate Valve installed on the flowline outlet and a Cameron "Flex-Seal" Mud Line Valve flanged to the choke outlet.

The Cameron Christmas Tree at right is a 15,000 lbs. test assembly with Cameron Ram-Type Tubing Control Head and Cameron Unitized Flow Wings.

Interested operators are invited to write for complete details on these and other Cameron products.

CAMERON IRON WORKS, INC.

711 Milby St. . . . Houston, Texas

Export: 74 Trinity Place, New York, N. Y. West Texas: Telephone 1710, Odessa. Oklahoma: 310 Thompson Bldg., Tulsa. California: 1442 Hayes Ave., Long Beach, (7-2036).

Shell Mara wildcat, and then to "Kilometer 24" structure, which is 24 kilometers from the Shell Palmarito field. We then cut across country on a jungle road driving through numerous mud holes to the Netick structure in the district Mara. We witness the drilling operations of the Orinoco Oil Company, have dinner at its wildcat camp, and then drive to the Orinoco Calentura, No. 2 on the west flank of the syncline. We see the exploded boiler that flew several hundred yards and finally landed in the dense underbrush.

In the afternoon we drive northwest to Tule Lake and have a fine view of the Andes Mountains separating Venezuela and Colombia. It is in these mountains that the famous Motilono Indians live. Between La Pas and Concepción we climb one of the typical iron rock hills for a 50-mile view in each direction showing the country we have traversed on our trip.

A tour of Maracaibo reveals the increasing influence of the modern trends in the growth of this city. The public markets are distinctly different from those at home; the displays of Venezuelan craft and handiwork show considerable dexterity and originality; we become engrossed in the silver and gold jewelry and particularly the orchid facsimiles that are so characteristic of Venezuela. We also stop to inspect the orphan school, the new ball park, and the many attractive homes springing up in well-ordered fashion along the tree-lined and modernly paved avenues and highways.

The next day we inspect the public school system for North Americans, which is up-to-date in every respect. The school is maintained jointly by Creole, Shell, and Mene Grande, with first-class teachers from the States who enthusiastically display the work of their students and comment with pride upon the modern methods permitted by the long-visioned companies. We learn that the schools for the Venezuelan children are equally efficient. Adult education is encouraged evenings.

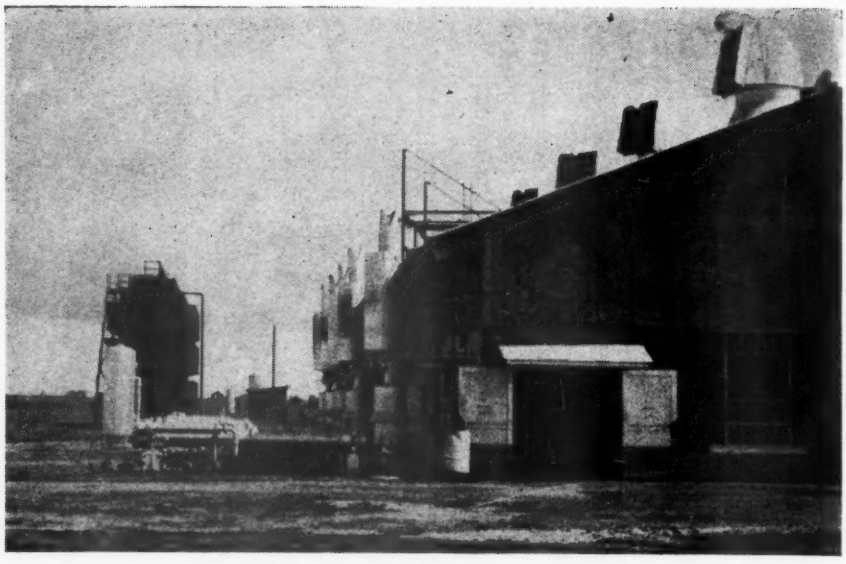
So much for our general impressions of Venezuela from Caracas to Eastern Venezuela and from thence to the Maracaibo region of the west. Part 2 will be concerned with matters more directly concerned with oil exploitation and exploration.

PART 2.

● **Petroleum concessions.** Under the Venezuelan constitution, the ownership of the subsoil belongs to the Nation. Under the early and present laws, the owner was given the preferential right to obtain a petroleum concession under his land. If he did not prepare the necessary maps, exploit and explore, the areas became in effect "free" zones. Once the period alloted the land owner for applying for a concesion over his property lapses, anyone may apply for a concession over the same property. After the application for a particular exploration-exploitation concession is made and accepted by the ministry, the concessionaire has three years in which to explore and map the concession. During this period preliminary surveying and geological work is done, permitting the concessionnaire to select one-half the area of the concession to be retained by him for 40 years as an exploitation concession. The exploitation area is divided into parcels of a maximum of 500 hectares each, and bounded by north, south, east, and west lines insofar as possible. Under previous laws, most concession boundaries were made in the form of rectangles. The area should not be more than five times as long as wide. The excess shown at the time of presenting the parcel maps as compared with the original application of the concession owner (sobrante) is excluded and reverts to the Government. The remainder of the concession is then divided into parcels and National reserves, the total areas of which are equal as mentioned. If the residual concession area is smaller than specified in the application, it is divided equally between the parcels and the National reserves. The National reserves revert to the Government in a manner similar to the "sobrante" areas.

In addition to the exploration-exploitation concessions, the concessionnaire may also apply for concessions directly. The only requirement is that the concessionnaire shall divide the concession into parcels of 500 hectares or less, the concessionnaire taking the entire area of his application. Usually these National reserves in the "sobrante" areas are put up for auction.

● **Initial investments.** Foreign operations involve heavy expenditures for exploration work, and for production, storage, and transportation facilities. A long time lag usually exists between the initial investment and the initial returns. Houses, camps, shops, hospitals, and schools must be built. The companies usually drill their own wells after long periods of exploration without income. For instance, one company beginning exploration outside Maracaibo is reported to have spent $48,000,000 before moving the first oil to market ten years later.



Pipe line station of Mene Grande Oil Company, enroute to Puerto la Cruz.

● **Drilling—Eastern Venezuela.** The first wells at Oficina, the original discovery area in Eastern Venezuela, required from 60 to 150 days to drill. This drilling time was eventually lowered to 30 days or less. Casing was set ordinarily in from 18 to 24 days. Depths averaged 5500 ft. with a few below 6000 ft. Drilling began in the East and West Guara

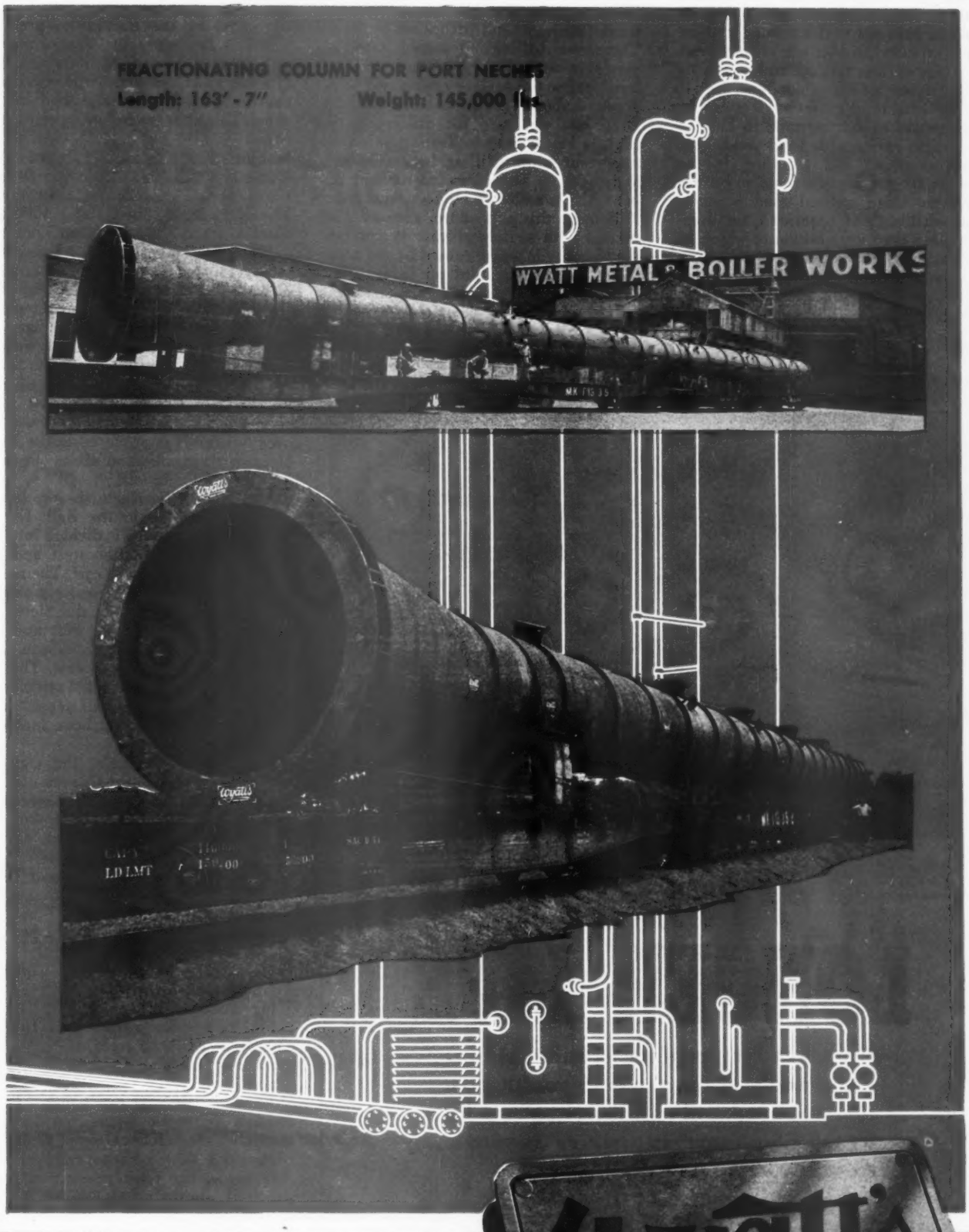
It costs only a few cents to use RECTORSEAL on thread connections to make them permanently leak-proof. This precaution when making up connections will prevent such costly operations as pulling strings of pipe, taking up drilling and flow lines, breaking out christmas tree and separator connections, to stop leaks which develop in connections not properly protected.

RECTORSEAL not only costs little to use, but is easy and quick to apply. It can be swabbed or brushed directly from the container.

Save costly connection leak repairs by getting RECTORSEAL No. 1 from your supply store now!

RECTOR WELL EQUIPMENT CO., INC.
FORT WORTH, TEXAS
Export: Lucey Export Corp., Woolworth Bldg., N. Y. C.

RECTORSEAL
THE POSITIVE LEAK PREVENTER



Fabricating towers to rigid specifications for modern petroleum refining requires technical "know-how" gained from years of experience plus proved methods and superior plant facilities.

•

WYATT METAL & BOILER WORKS

areas later in 1943, average depths being 7000 ft. The completion time here averaged 45 days per well where no particular mechanical trouble was encountered, or where coring, testing, and squeezing off the upper zones was not done.

● **Drilling mud—Eastern Venezuela.** The control of drilling mud in Eastern Venezuela varies with local conditions. Mud treatment and handling in the Greater Oficina area presents no serious problem. Good natural mud is made while drilling and requires little attention other than the addition of water. In Guara, mud for spudding is pumped to a new location before the rig is dismantled at the previous well. If necessary, this mud is fortified with bentonite and thickened with cement before or during the spudding operation. After surface casing is cemented, pits and ditches are cleaned. Thereafter drilling is resumed, using a very thin mud. The formations encountered below the surface casing and to a depth of about 3500 ft. make good mud. Drag bits are used for drilling until slightly below 4000 ft. Testing becomes important while drilling between 4500 and 5000 ft. The indicated amount of bentonite is added to reduce water loss. Following this procedure, the mud is treated with sodium silicate to correct the viscosity increase caused by the bentonite. In the standard pit layout, the volumes are such that as a rule ten sacks of bentonite and the chemical necessary for correcting viscosity increase will lower the water loss of the mud 1 cc. as measured by the Baroid low-pressure wall-building apparatus. Thereafter, the only treatment required is the addition of water and Quebracho, with or without caustic soda. The average mud in this general area has the following characteristics:

Weight	75 lb. per cu. ft.
Water loss	13 cc. per 30 min.
Filter cake	⅛ in., minus
Viscosity	20 to 22 sec. Marsh 1500/500
Sand	less than 5 per cent

When Schlumberger depth is reached, the viscosity is again lowered if excessive in order to facilitate running the electrical survey. In general, maintenance of mud in the Greater Oficina area requires very little chemical and no weighting materials whatsoever.

● **Production.** The total crude oil production for Venezuela is now over 1,000,000 bbl. a day, of which a little over two-thirds is produced in the basin of Lake Maracaibo and about one-third in Eastern Venezuela.

In Western Venezuela the producing fields are located in the Zulia-Falcon trough, which in turn is divided into the Maracaibo Basin on the west and the Falcon-Lara area on the east. The northeast-southwest trends have been caused by compression between the Sierra de Perija mountains on the west and the Venezuelan Andes and Caribbean Cordilleras on the south and east. The entire basin has been controlled principally by subsidence in the small geosyncline, the Eocene beds having been included in the folding.

In Eastern Venezuela, the Orinoco Trough lies between the Guayana Shield on the south and east, the Venezuelan Andes, Caribbean Cordilleras, and the Paria-Araya metamorphic area on the west and north.

Three of the producing areas of Venezuela contribute the major portion of the production, as follows:

	Bbl. per day
The Maracaibo Lake Basin fields of Western Venezuela	700,000
The Monagas area, comprising Jusepin, Quiriquiri, Mulata, and Santa Barbara	165,000
The Greater Oficina area, including Oficina, Guara, and Leona	125,000

Another principal producing area in Eastern Venezuela is the San Joaquin group, which includes Guario, El Roble, Santa Rosa, Rincon-Largo, and the Santa Ana fields, the total production from which is approximately 25,000 bbl. a day. A comparatively small amount of crude is produced at Temblador and Cumarebo.

The San Joaquin group is distinctly different from other Eastern Venezuela groups in that all are anticlinal or dome structures. The Jusepin group are all basically stratigraphic traps with some faulting, being the result of wedgeout of the Miocene, Eocene, and other formations against the northern coast range of mountains.

You'll Get

LONGER LIFE

from hard-to-replace refining equipment and storage tanks if you'll have them cleaned and painted regularly by STOKES. Your inquiries invited. Address:

R. A. STOKES

INCORPORATED

635 Nixon Bldg. Phones 2-2101, 5316

Corpus Christi, Texas

McEvoy Self-operating GAS LIFT

Because of its unique operating principle the McEvoy Gas Lift ***automatically*** adjusts itself to well conditions and works at peak efficiency all the time.

The schematic diagrams at the right show how the valves adjust themselves automatically to well conditions. Three valves are shown for illustration, but operation would be similar with more valves.

Condition A. This diagram shows well conditions before gas is turned on.

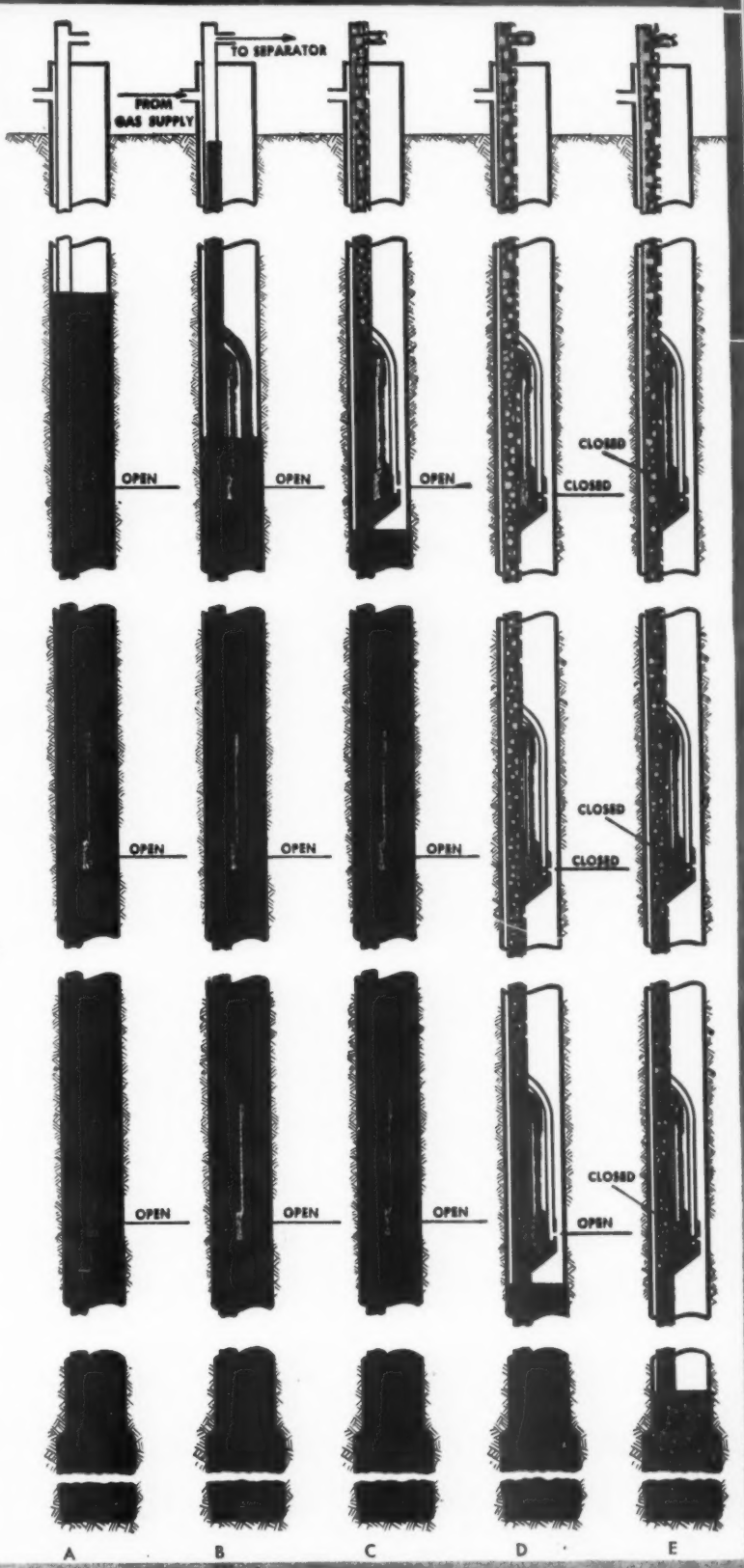
Condition B. Gas is being turned on but fluid level in casing has not yet uncovered port of first valve.

Condition C. The gas lift is producing from the first valve. Fluid level in casing is still receding. As the fluid level in the casing drops below each succeeding valve, the gas starts flowing through the lower valve and all upper valves are positively closed.

Condition D. Steady operating conditions have been reached. The lowest valve is admitting gas to the tubing. All upper valves are positively closed because the well fluid in the tubing at each upper valve is aerated.

Condition E. The well is producing enough formation gas to flow naturally. Notice that ***all valves are closed*** and ***no gas is being used.***

A McEvoy Gas Lift installation uses gas ***only*** when it is needed — then, since it admits ***all*** the gas used through the lowest valve uncovered, every cubic foot of gas does the most efficient lifting job possible. That's why McEvoy installations consistently give the lowest possible gas-oil ratio regardless of well conditions.



Sold Through Supply Stores Everywhere

McEvoy COMPANY

TEXAS AT MILBY • P. O. BOX 3127

HOUSTON 1, TEXAS

EXPORT SALES: E. F. GAHAN — Room 1223, 500 Fifth Avenue, New York, N. Y.

The Oficina group in Eastern Venezuela are all fault accumulations. Oficina itself is not one continuous reservoir, but is a system of faulting separating the field into several areas.

In the current year, wildcatting has increased in Guarico to the west of the established fields already noted in Anzoategui and Monagas in Eastern Venezuela. It has been reported that more than half of all the exploration concessions in Eastern Venezuela have been granted in Guarico. Production from the Las Mercedes field comes from three sand zones in the Miocene between 4000 and 4400 ft.

In the Maracaibo Lake Basin the bulk of the production comes from some 3000 wells. The four principal producing areas are Lagunillas, Cabimas, Tio Juana, and Mene Grande. Production is from the Miocene and Eocene, much of the offshore lake production being from the latter. Deeper drilling in the La Paz field northwest of the lake in 1944 established the upper Cretaceous. The opening of this deep pay was considered the most important development of the year in Venezuela because of the possibility it might be found underlying the Miocene and Eocene formations throughout other parts of the basin.

● **Production practice—West Guara.** Production practice in Western Venezuela is generally more or less known; however, the operations of West Guara in Eastern Venezuela will be described briefly since they do not follow the older practices.

Triple zone completions are common in this area. Oil flows from the lower perforations through the nipple and 2-in. tubing. Oil from the intermediate sand flows through the annulus between the tubing and the 4-in. intermediate string, and from the upper perforations the oil flows through the annulus between the 7-in. and the 4-in. pipe. With an area of only 3500 acres, the possibilities of future production from this field are unusual since some 39 separate sands have been identified. The field has been developed on a two-grid pattern, each of which is uniformly spaced. The upper grid ranges from about 4500 ft. to about 5500 ft., and the lower grid varies from 5500 ft. to 7900 ft.

● **Pipe line and port facilities.** Two 16-in. pipe lines of the Mene Grande and Creole companies terminate at Puerto La Cruz, the oil port of northern Anzoategui. The Travieso-Puerto La Cruz line is 154 kilometers long and has a capacity of 98,000 bbl. The Oficina-Puerta La Cruz line is 160 kilometers long with a loop of 22 kilometers, and has a capacity of 150,000 bbl., which will be increased to 160,000 bbl. when an additional loop 12 miles long is placed in operation late in 1946.

At Puerto La Cruz the transfer station has a capacity of 7500 bbl. per hr., and a generating capacity of 500 kw. An additional generator unit will increase this to 850 kw. Two 24-in. loading lines have a capacity of 22,000 bbl. per hr. each. The port storage capacity, counting additional tanks now nearing completion, will be 3,000,000 bbl. The incoming oil is stored in loading tanks, if available. Otherwise the incoming oil is run to storage tanks and then transferred to the loading tanks.

Four grades of crude are handled: Amana (Jusepin-Santa Barbara) 33 deg.; Oficina blend, 34 deg.; Oficina light, 39 deg., and San Joaquin grade wax, 45 deg. The pour point of the wax oil is 83-84°, but this crude can be handled satisfactorily if aeration is prevented.

The loading dock accommodates two large ships of maximum capacity of 135,000 bbl. each. Material imports at Puerto La Cruz during 1945 averaged over 10,000 tons per month, with a maximum in any one month of 21,000 tons. The material dock berths one cargo ship and is equipped with a 50 ton revolving crane. An additional dock of equal size is contemplated.

Immediately to the east of this terminal on the same harbor is the Consolidada (Sinclair) ocean terminal, handling the production from the Consolidada Santa Barbara and Muri fields, which arrives at Puerto La Cruz through the Consolidada 10-in. pipe line of some 150 kilometers in length. A pipeline from the Guarico area to a marine terminal east of Guanta near Puerto La Cruz has been projected.

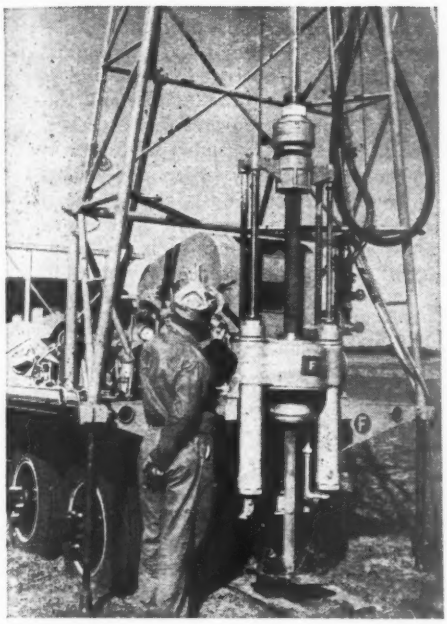
The Eastern Construction Co., Inc., incorporated August 1, will take over the work and activities of the Eastern Construction Company, an unincorporated firm. The following officers were appointed:

C. Hobson Dunn, President
J. W. Hall, Vice President
Miss E. A. Anderson, Secretary-Treasurer

This reorganization will enable us to render better service and greater efficiency in pipe line construction. Let us handle your next job.

Eastern
CONSTRUCTION CO., INC.
PIPELINE CONSTRUCTION
1801 MERCANTILE BANK BLDG., DALLAS 1, TEXAS

We are mighty proud of the Failing 1500 and the Failing 2500, OUR FIRST TWO POST-WAR PRODUCTS



THE FAILING 1500 HOLEMASTER is rated to drill 5-inch diameter holes to a depth of 1500 feet. Larger diameter holes with heavy duty drillhead and 4½ x 6 pump.

The standard drillhead is the rotary type with hydraulic feed, 30-inch stroke. Rotary has three speeds forward with high speed reverse. Kelly size, 2⅜-inch. Drillhead retracts hydraulically 14 inches to permit addition of drill pipe, running of casing and other operations.

The draw works is fully enclosed and compactly designed as a unit with the drillhead. Driven through spiral-cut bevel gears and double roller chain drive. Double disc friction clutch directly in drum for flexibility of operation.

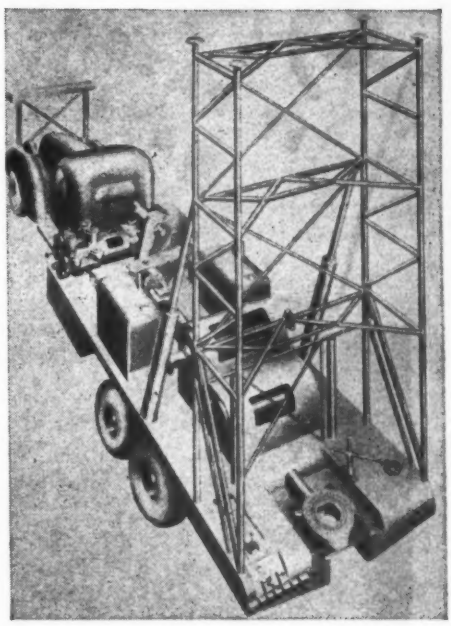
The weight of the standard drill is 7,750 pounds. Drill may be mounted either on 1½ or 2½-ton truck, having 146" to 158" wheelbase, with approximately 250 cubic inch displacement engine.

WE'RE ALSO MIGHTY PROUD of the fine reports that are coming back to us from the field on the fine operation of our new post-war products . . . the FAILING 1500 and the FAILING 2500 Drills. Here's a sample of the wonderful things drillers and drilling contractors are saying about them:

> "We are building up such a good reputation with our FAILING rig that we need another one to keep up with our work . . . in this territory (South Texas) FAILING rigs are out in front and we are going to keep them there."

Such fine testimonials on the performance of our products make us extremely happy . . . It gives us further confidence in our established policy and practice of building the finest drilling equipment that possibly can be built. When you buy a FAILING drill, you know you are getting the best.

*—Name on request.



THE FAILING MODEL 2500 is the most advanced drilling equipment being produced today. The use of a newly designed, balanced crown block insures even loading of the mast legs. The mast is sectional and designed to permit the addition of extra length. The light weight, all-steel, oil bath, rotary table is easily removed and adapted to special drive and table frame holder for rathole drilling. The new type double draw works is actuated by two air clutches. A patented floating gear box of advanced design incorporates smooth application of power to draw works and rotary table. The heavy duty transmission provides four rotating speeds and one reverse. Dual Engines are coupled through a special hydraulic cushion drive that makes possible any drive application, from individual, to compounding of engines to drill and pump. Hydraulic throttles give perfect synchronization when motors are compounded. The duplex, 5 x 10, reciprocating mud pump is unitized with the drill. Fingertip air controls are grouped for ease of operation and identification by driller. The new breakout arrangement consists of a mesh drive from table to spring actuated slips, which have steep angle inserts with pyramid cut teeth providing a firm grip on tool joints. (This breakout arrangement is available when 2⅜" or 2⅞" exploration drill pipe is used.) Two patented, jack sub-structure assemblies are provided for stabilization of the drilling unit.

Geo. E. Failing Supply Co.

MANUFACTURERS · PORTABLE DRILLING EQUIPMENT

HOUSTON, TEXAS · ENID, OKLAHOMA · MIDLAND, TEXAS

EXPORT OFFICE · 30 ROCKEFELLER PLAZA · NEW YORK 20, N.Y.

9 Reasons why IT PAYS TO SPECIFY NAYLOR PIPE

1 Light weight saves steel.
2 Easier to handle.
3 Cuts installation time.
4 Stronger, leaktight, safer.
5 Accurate diameter.
6 Holds true cylindrical form.
7 Handles jobs normally requiring heavier-wall pipe.
8 Saves maintenance.
9 Saves money.

No Other Light-Weight Pipe Combines These NAYLOR Advantages

The difference between Naylor and all other light-weight pipe is the Naylor Lockseam Spiralweld structure. This accounts for the light weight, greater strength, accurate diameter, leaktightness, exclusive safety factors and greater economies.

Sizes from 4″ to 30″ in diameter with all types of fittings, connections and fabrications.

Call our distributors or write direct for the new Naylor Catalog which gives you all the facts.

Naylor

MID-CONTINENT SUPPLY COMPANY
FORT WORTH, TEXAS and Branches
EXCLUSIVE DISTRIBUTORS IN ARKANSAS, KANSAS LOUISIANA, NEW MEXICO, OKLAHOMA and TEXAS

NAYLOR PIPE COMPANY
1240 East 92nd Street • Chicago, Illinois

● **Well testing and decline in Eastern Venezuela.** Insofar as possible, flowing well declines are based primarily upon rates successively established for minimum gas-oil ratios. Chokes of increasing cross-sectional areas become necessary as the pressure-production-depletion relationships change in the predominately gas-drive types of reservoirs. Hence, the extrapolation of such production rates with time as the abscissa, aids in the estimation of future production rates, but only up to the dates the wells cease to flow. A new decline history must be initiated in order to assist in the estimation of future artificial lift production.

● **Refineries.** The principal existing refineries are at Caripito, Aruba, and Curacao. A new law requires that a certain percentage of the crude produced in Venezuela must now be refined within the country. Accordingly, at least three new refinery projects are in various stages of development, each to be of 40,000 to 50,000 bbl. capacity. One is to be at Puerto La Cruz, one on the coast at Turiamo, and one at Punta Cardon on the Paraguna Peninsula.

● **Climate.** The climate in Venezuela depends on several factors such as (1) Dry or wet season; (2) elevation above sea level; (3) accessibility of prevailing trade winds, and (4) degree of precipitation and the effect on humidity. The dry season begins in December and lasts through March. The northeast trade winds are more intense during the dry season, and, although the temperature differences are not large, the lessened humidity results in greater personal comfort. The wet season, lasting from March to December, is characterized by local daily rains, hot days and comfortable nights, especially where the trade winds have free access. The climate three degrees north of the equator in Eastern Venezuela compares favorably with many areas of the United States; however, although the temperatures are not excessive, the direct sun rays appear to be more penetrating and promote overexposure. The following weather statistics were prepared from information obtained in San Tomé, Eastern Venezuela:

	Dry season	Wet season
Temperatures		
Maximum	91° F.	93° F.
Minimum	68° F.	71° F.
Humidity	52 per cent	62 per cent
Precipitation per month	0.3937 in.	4.72 in.

● **Health.** Medical science has done much to reduce diseases that one would expect in foreign countries such as Venezuela. Well-equipped hospitals have been provided with first-class equipment in every respect, including X-ray and diagnostic laboratories. The industrial-tropical physician has many duties beyond those found to be necessary here. He must be responsible for the precautions necessary in wildcat camps with respect to typhoid, dysentery, malaria, yellow fever, etc. In addition he is concerned with water supplies, meat inspection, sewage disposal, and other sanitary measures. Health conditions in the average oil company village compare favorably with the healthier communities in the United States. ★★★

Canada has intense exploration program*

By **RICHARD SNEDDON,** *Pacific Coast Editor*

EXCLUSIVE

OF ALL the nations of the world, Canada's per capita consumption of petroleum is exceeded only by that of the United States, and her proved reserves, representing approximately one-tenth of one per cent of the world's total, are hopelessly inadequate to satisfy the national need. Production stems from two major fields, Norman Wells in the Northwest Territories, and Turner Valley in Alberta, which together account for a meager 15 per cent of overall requirement. To make the situation more precarious still, Norman Wells is so remotely situated, that without a more copious yield and more prolific reserves, it is uneconomical to transport the crude to more densely populated areas. By the same token, it must not be forgotten that Turner Valley reached its maximum effective yield of 28,410 bbl. a day, in February, 1942, and has since steadily declined to its present productive rate of 20,000 bbl. a day.

It is obvious on the basis of these facts that Canada, a nation of incalculable natural resources, has only one alternative: she must prosecute unabated her search for new petroleum reserves, while she continues to import such additional oil as is required by a modernistic, progressive nation, whose standard of living is high. The agricultural industry, and other thoroughly modern enterprises, including fisheries, mines of infinite variety, lumber mills, pulp and paper mills, etc., are competing in world markets, and oil is a highly pertinent factor. It is fortunate, indeed, that much of Canada's demand can be supplied by water from South America and the United States, and some of it even by pipe line, as at Sarnia, Ontario, the two cheapest forms of transportation. Imperial Oil Limited, the largest operating petroleum organization in the Dominion, acquires some 80 per cent of its requirement by these two means. The remaining 20 per cent, however, goes to inland refineries at Regina, Saskatchewan, and Calgary, Alberta, and must either come from local producing fields, or else be hauled long distances by rail at high cost.

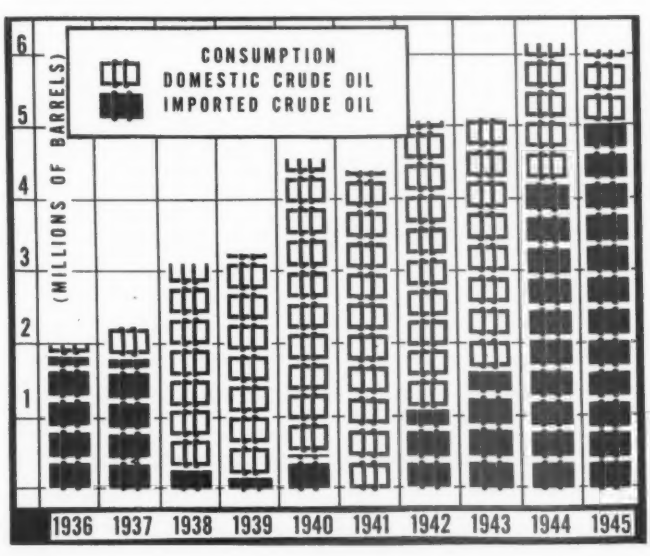
The prospect of supplying the prairies with water-borne crude, via Vancouver, British Columbia, or Churchill on the Hudson's Bay, has been debated, but for the moment, these routes present difficulties that cannot be overcome economically. Transportation costs are of great significance in evaluating the Canadian oil situation. Before 1936, production from Turner Valley was inconsequential, and most of the crude used in Alberta and Saskatchewan refineries was imported from the United States, largely from the Cut Bank field in Montana. The price of gasoline, of course, was governed by cost at the well of this imported crude, plus transportation cost, and the tankwagon price, that is, the price to the dealer was 21.5 cents at Calgary, and 22 cents at Regina.

Early in 1937, Turner Valley was producing enough oil to displace some at least of the imported crude in Alberta refineries, and by the end of the year, was beginning to reduce the quantity of imported oil required in Saskatchewan, also, with the result that at the close of 1937, tankwagon prices had dropped to 17.5 cents at Calgary and 20.5 cents at Regina. Thereafter, Alberta production steadily increased, until in 1941 imported crude for these two areas was completely replaced by this domestic supply, and by the end of the year, tankwagon prices were 16 cents at Calgary and 18 cents at Regina.

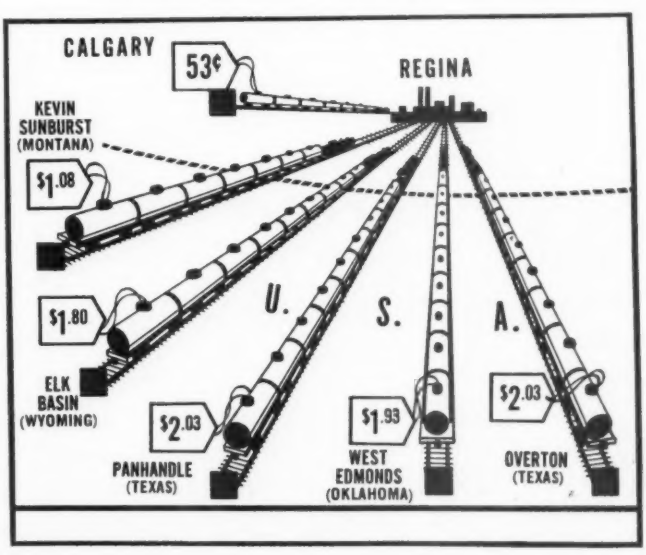
That was the one and only year, however, in which Alberta crude oil production was sufficient to meet the needs of its neighboring province as well as its own. Wartime came, exacting new and hitherto unprecedented demands on the refiners of these two provinces, and although Turner Valley reached its all-time high in 1942, it was necessary to import more than a million barrels in that year, to conform with the emergency program. The demand in 1942 with Turner Valley now on the decline, was three times what it had been in 1936, and it was increasing daily. Thus, more and more oil was imported into Saskatchewan, until in 1945, imports totalled more than five million barrels.

*Illustrations and most of the data for this article were supplied by the Imperial Oil Review, Toronto, Canada.

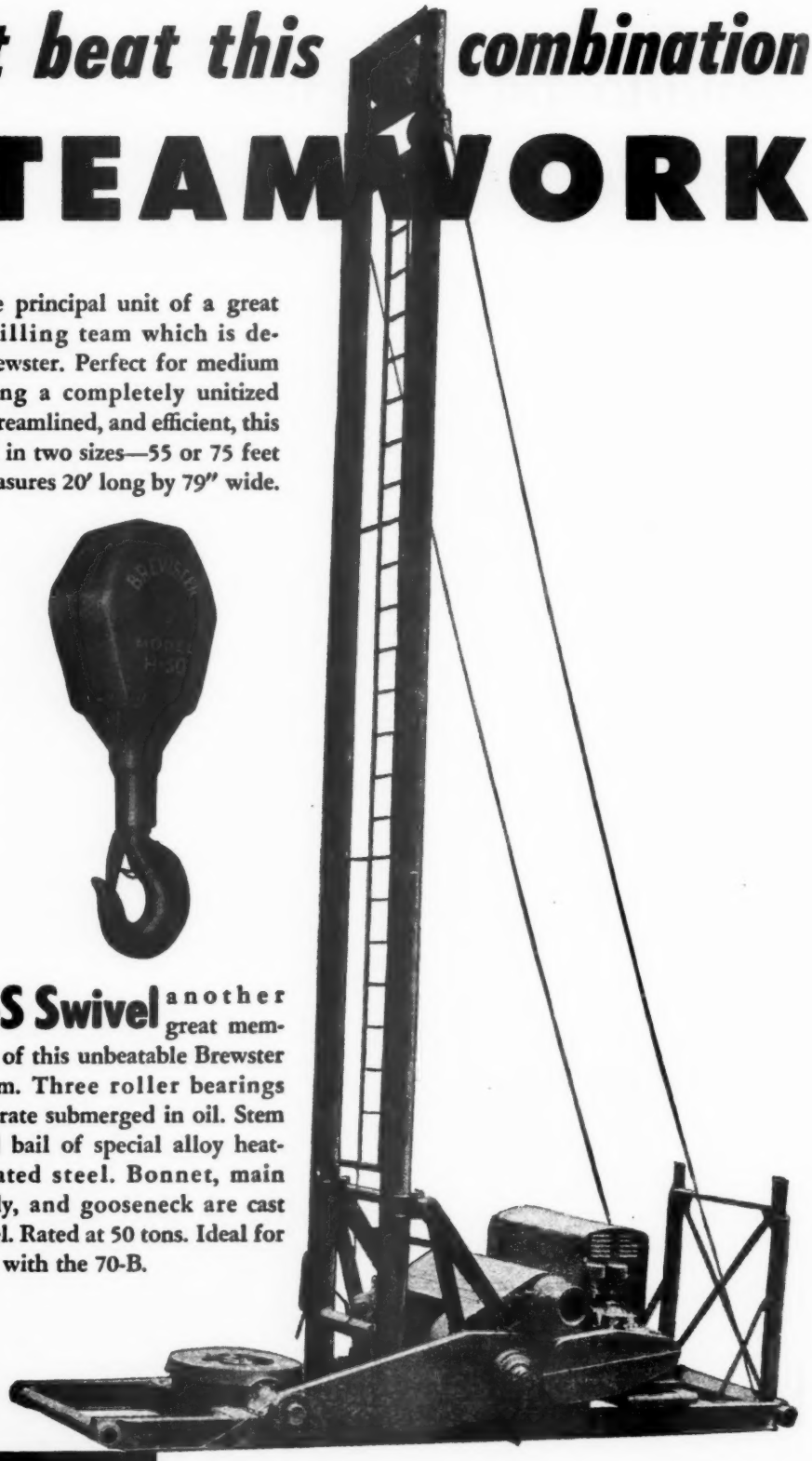
Saskatchewan has never produced enough crude oil to fill its requirements, and needs new reserves to obviate the necessity of importing crude at high cost. In the first five months of 1946 consumption was 2,058,000 bbl., most of it imported.



Transportation costs are a major factor in Canada's petroleum picture. Here are shown costs per barrel between various sources within the Dominion and the United States, and Regina, Saskatchewan.



You can't beat this combination for TEAMWORK



70-B RIG the principal unit of a great drilling team which is designed and built by Brewster. Perfect for medium depth drilling, featuring a completely unitized drawworks. Compact, streamlined, and efficient, this portable rig is available in two sizes—55 or 75 feet fully extended. Skid measures 20′ long by 79″ wide.

H-50 Block the Brewster-built block expressly designed for use with the 70-B. Rated at 50 tons. Many feet of mast are saved by this combination hook and block. Three 22″ sheaves with machined flame-hardened API grooves. Internally lubricated roller bearings for smooth operation.

3-S Swivel another great member of this unbeatable Brewster team. Three roller bearings operate submerged in oil. Stem and bail of special alloy heat-treated steel. Bonnet, main body, and gooseneck are cast steel. Rated at 50 tons. Ideal for use with the 70-B.

THE BREWSTER CO. INC.

For Over 30 Years Makers of Fine Oil Field Equipment

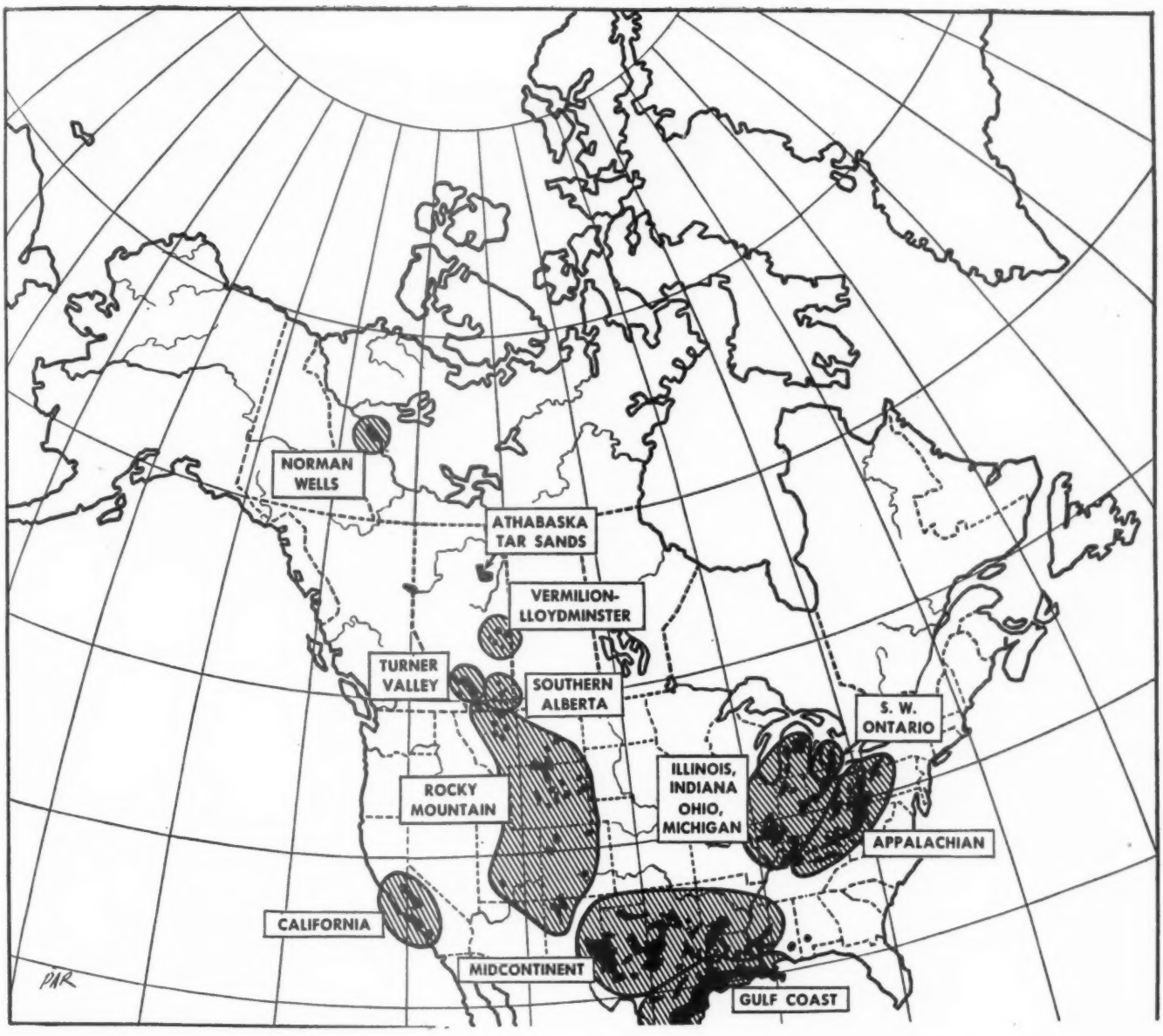
SHREVEPORT LOUISIANA

EXPORT OFFICE—Acme Well Supply Co.
19 Rector St. New York City U. S. A.

SOLD BY THESE SUPPLY STORES:

Iverson Tool Co. Reams Supply Co.
General Mach. & Tool Co. Industrial Supply Co.
Clark Bros. Industrial Supply Superior Iron Works & Supply Co.

BREWSTER ALSO BUILDS other types of Portable Rigs, Drawworks, Winches, Reels, Crown Blocks, Travelling Blocks, Tubing Blocks, Oilbath Rotaries, Casing Heads, and Tubing Heads. Write for information!



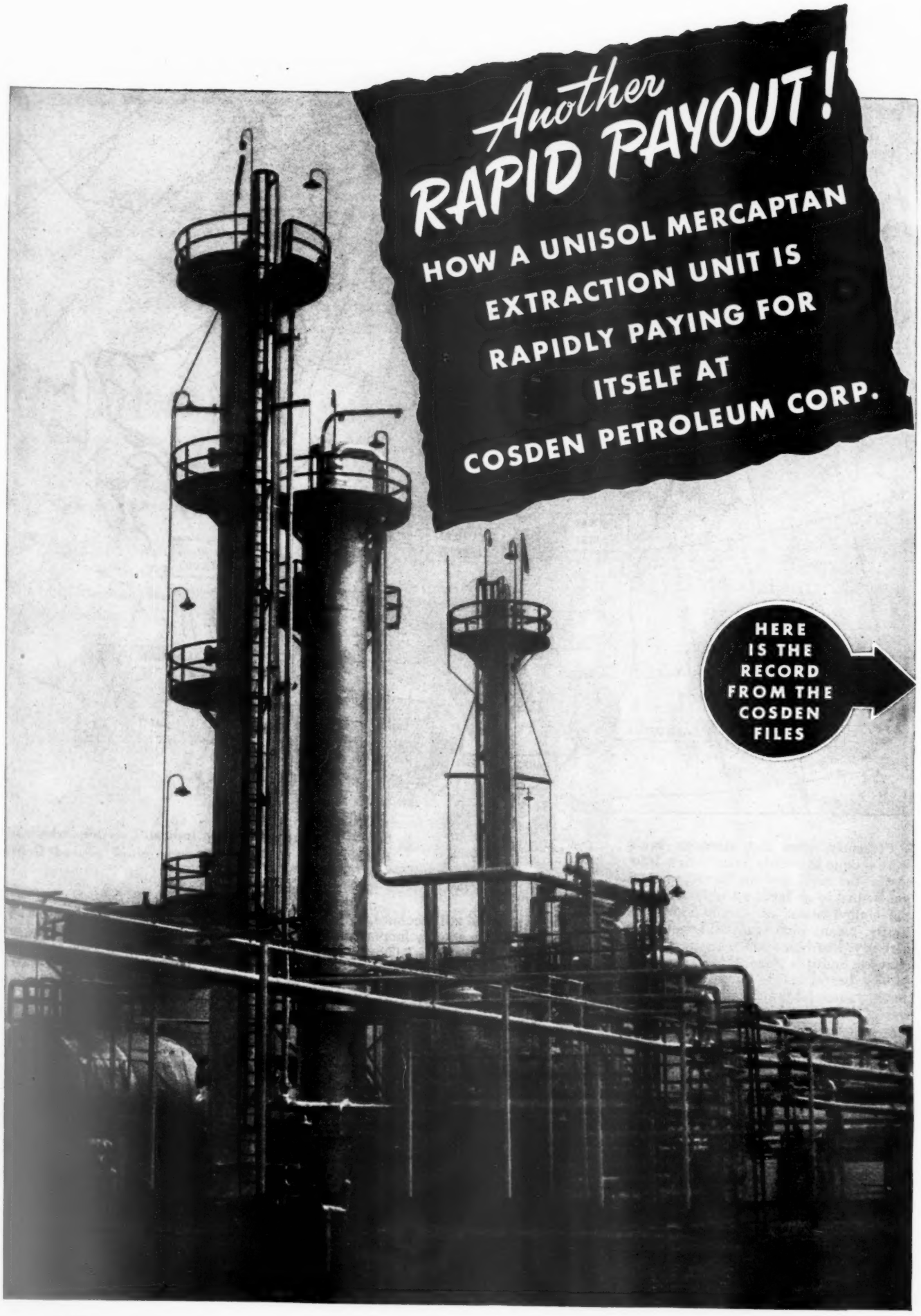
Shading in the above map indicates sections where oil is known to exist. Black areas show proved fields.

Presently, even the Montana fields were unable to supply more than a fraction of the need, and the Canadian companies had to go farther and farther into the United States for crude. This, naturally, meant increasing still more the already burdensome transportation charges, and it is a fact that as much as $1.93 a barrel had to be paid for transporting some oil into Regina during the war period. It might have been expected that this large scale importation of expensive crude oil would have boosted gasoline prices to a prohibitive degree in Saskatchewan, but the Canadian government held firm control of price ceilings, and paid subsidies to the refiners to help neutralize the increased costs. Now, with the war over, subsidies on imported oil have been reduced, and the cost has gone up to 45 cents a barrel. A simultaneous and corresponding increase in the price of Alberta crude has been allowed so that domestic producers will not be penalized through the application of the subsidies.

Strenuous and costly efforts have been made to find new oil reserves in Alberta, but the daily yield still declines, and the production cost gradually increases. Total production in 1945 was 8,055,440 bbl., as compared with 10,157,398 in 1942, a drop of 2,101,958 bbl., approximately 25 per cent, and the importance of amplifying the domestic supply is immediately obvious. It is unfortunate that exploration and drilling costs are unduly high in Canada's most likely areas. Denotative outcroppings are rare on the prairie lands and geophysical methods must, therefore, be employed to correlate subsurface data. In the foothills, the formations that one might expect to be oil-bearing, lie at great depths, and the strata above these are hard and difficult of penetration.

Trends are still further indicated by some of the most recent figures. During the first five months of 1946, Alberta's Turner Valley field produced 2,788,188 bbl. of crude. Alberta consumed in this period 2,654,131 bbl., of which 2,543,544 were of Canadian origin and 110,587 imported. The province of Saskatchewan consumed 2,058,600 bbl. of oil, of which 120,508 bbl. were derived from Canadian fields and 1,938,092 bbl. imported.

What local discovery means to Canadians, particularly those on the prairies and other territories remote from presently available supplies of crude, is illustrated by the effect of the Fort Norman discovery. This field is well known as the Canol project. First consequential production came from three wells, near the bank of the Mackenzie River, about 75 miles below the Arctic Circle, following the original discovery in 1919. A small skimming plant was built nearby to manufacture gasoline for the few trappers and fishermen who had their headquarters in the area. The operation of the plant resulted in a gasoline price drop from $2.50 a gallon to 90 cents, and


Another
RAPID PAYOUT!
HOW A UNISOL MERCAPTAN EXTRACTION UNIT IS RAPIDLY PAYING FOR ITSELF AT COSDEN PETROLEUM CORP.
HERE IS THE RECORD FROM THE COSDEN FILES

In December, 1945 a UNISOL Mercaptan Extraction Unit was put into operation replacing a caustic mercaptan extraction unit and doctor sweetening unit at the Big Spring, Texas refinery of Cosden Petroleum Corporation. A careful full scale plant comparison between UNISOL treatment and caustic and doctor treatment was recently completed.

The two operations are compared directly at a leaded octane number of 73.5. This is the octane number at which the gasoline was being sold at the time the caustic mercaptan extraction plus doctor sweetening run was made. This comparison shows substantial savings at 73.5 octane number. However, all of the UNISOL treated cracked gasoline can be raised to 76.5 octane number with 2.8 cc TEL which after blending to the desired vapor pressure with casinghead and butane readily reaches 80 octane number.

GASOLINE TREATED: West Texas Cracked • 0.1% Mercaptan Sulfur
5 lb. Reid Vapor Pressure • 380° F. E. P.

Savings at 73.5 octane number $325 per calendar day

COMPARATIVE RESULTS

Octane numbers and lead susceptibility

Treatment	Caustic Washed & Doctor Sweetened Octane No.	UNISOL Treated Octane No.
	66.6	68.3
Clear	71.1	73.1
+1 cc.	73.3	75.3
+2 cc.	74.6	76.7
+3 cc.		

COST OF TWO OPERATIONS

(UNISOL Plant Designed for 5000 BSD. Comparison Based on Throughput of 3200 BCD*)

Treatment	Caustic Washing & Doctor Sweetening	UNISOL TREATING	SAVINGS ($ per calendar day)
T. E. L. cc./gal. 73.5 octane no.	2.15	1.15	
$/CD (0.2¢/cc. T. E. L.)	579	310	$269 lead saving
Direct operating costs ¢/bbl. thruput	5.25	4.20	
$/CD	168	134	$34 saving on operating costs
Increased recovery		0.9	
Estimated gasoline loss, %	1.2	28.8	
BCD	38.4	66	$22 saved through reduced gasoline loss
$/CD	88		

Total Savings for UNISOL $325 per day • Payout 397 days

**Charging stock for full capacity not available.*

This is a remarkable example of the efficiency and economy of a UNISOL Mercaptan Extraction Plant. Originally costing $129,000, it is quite apparent that the entire cost of this plant will be paid off in a relatively short period.

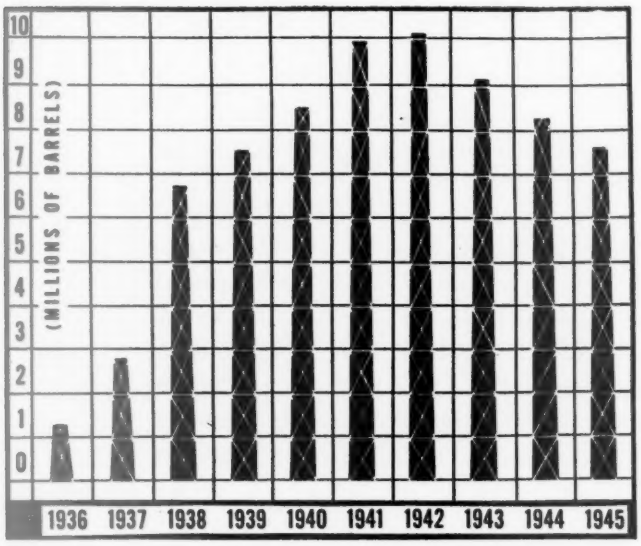
The need for this UNISOL unit was recognized by Universal service engineers, and its installation was recommended to the Cosden management. It was installed as part of a refinery-wide revamp to meet the higher octane number requirements of postwar competition.

UNIVERSAL OIL PRODUCTS COMPANY

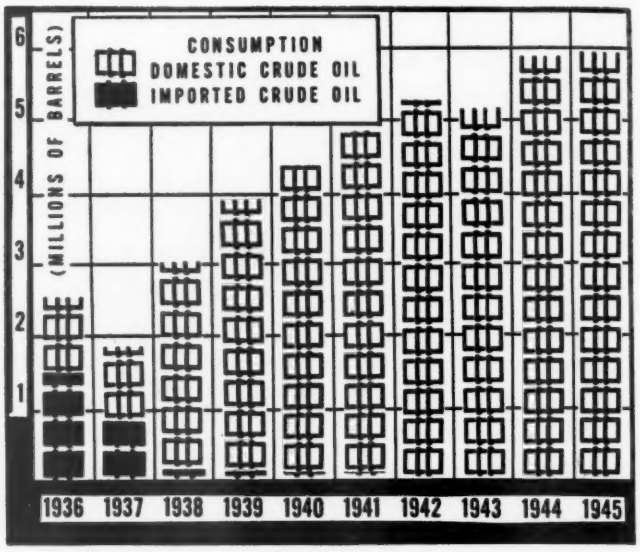
General Offices: 310 S. MICHIGAN AVE. UOP CHICAGO 4, ILLINOIS, U. S. A.

LABORATORIES: RIVERSIDE, ILLINOIS

UNIVERSAL SERVICE PROTECTS YOUR REFINERY



Crude oil production in Alberta, Canada, where the decline of Turner Valley is one of the reasons for the accelerated exploration program that is now under way. The first five months of 1946 Turner Valley field produced 2,788,188 bbl. crude oil.



Crude oil consumption in Alberta, where from 1938 to the end of 1945, local production has been adequate for local need. With the decline of Turner Valley, however, additional reserves are required. In the first five months of 1946 Alberta consumed 2,654,131 bbl., of which 110,587 was imported.

later actually to 30 cents, which shows in principle at least, what transportation costs do to commodity prices in such remote places.

One might think that Canada had no recourse but to resign herself to a program of importation, and be satisfied that at least there is oil to import, but there is little satisfaction in the acceptance of any such situation. To begin with, United States drew much too heavily on her own resources during the war, and is still consuming oil at an exceedingly high rate. She is likely, thus, to become more and more reluctant to dissipate her remaining reserves, and consequently more conservative in the disposition of future production. This, then, is a further stimulation for the vigorous search that Canada has been carrying on, largely in Alberta and the west, for the past few years. Millions of acres have been leased in Alberta, particularly on the Southern Plains, with the understanding that they must either be thoroughly explored or drilled before the end of 1946.

The Dominion has other possible avenues of escape from the threat of an eventual petroleum famine, as well as the immediate inadequacy of domestic supplies and the costly purchases of foreign crude. There is, for example a chance that synthetic processes, such as the Fischer-Tropsch method, may yet be found to make petroleum from coal or natural gas, more cheaply than is now possible. In addition, it may be remarked that the Canadian Government is still experimenting with the Athabaska tar sands in the hope of perfecting extraction and refining methods at a cost that will render them economically applicable. The Athabaska tar sand deposits are incredibly large, and even if in the meantime the cost of treatment is prohibitive, they constitute a potential source of supply that will inevitably be realized, and will then become a strong factor in the national program.

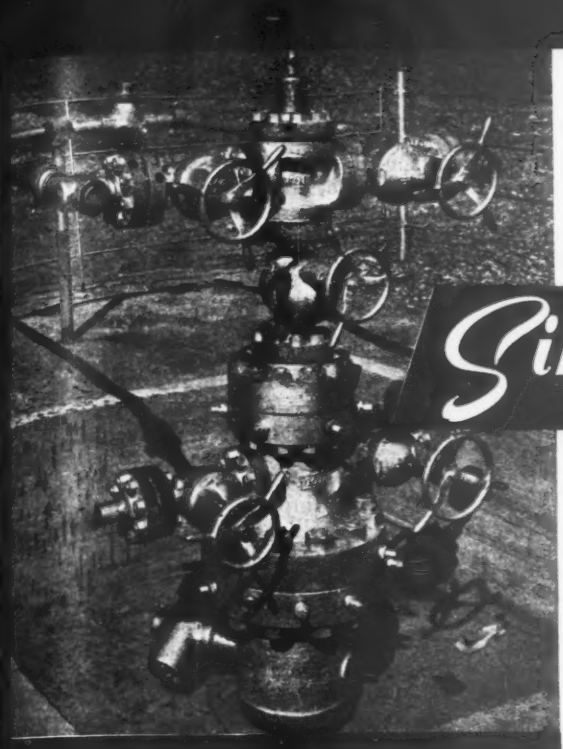
There is some consolation to be taken from the fact that while Turner Valley, the most prolific field, has been slowly declining for the past five years, the total production from wells outside the Turner Valley area has been increasing, although not enough to offset the aforementioned decrease. The active regions in Alberta are known as the Foothills, Southern Plains, and Central Plains areas, and there were drilled altogether in these three areas in 1945 some 53 wells, with 11 discoveries resulting, most of which were in the Southern Plains, and all of which were small producers.

All this exploration, however, is highly educational, besides being expensive, and may yet lead to substantial discovery. Imperial Oil Limited has always been very active in exploratory work on the prairies, beginning with the drilling of a well in 1917 near Conklin, Alberta, on the Alberta-Waterways Railway. Following this, in 1919 the company sent twelve geological parties out to the western provinces, and since that time has continued geological and geophysical surveys with varying degrees of success. Imperial played an active part in the discovery and early development of Turner Valley, and was solely responsible for the development of Norman Wells, Canada's largest reserve.

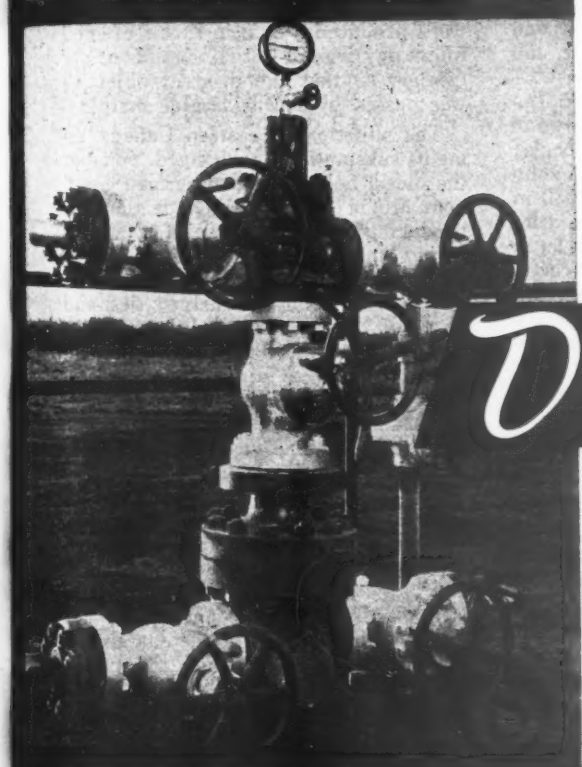
Before discussing Norman Wells further, it should perhaps be mentioned that the only consequent production of oil in Saskatchewan is from Lloydminster, just over the eastern Alberta border. There were at the end of 1945, a half-dozen wells in this field, producing a little more than 300 bbl. a day of low gravity oil. The field was just discovered in 1945 and as of the end of the year had produced slightly less than 16,000 bbl. of crude.

The entire western area of Canada is in reality relatively untested. Sedimentary deposits lie in various thicknesses, from the Rockies far out across the prairies, and from the southern limits of the prairie lands north to the Arctic. In the Rockies they run to a depth of ten miles or more, and then taper off in the east to more shallow depths. Every device known to the geologist has been used to procure fundamental data on the bases of which subsurface conditions might be determined, but in spite of the extensive use of aerial photography, continuous study of contours and outcroppings, examination of seepages, and other geological data, it is still necessary to drill in order to get really reliable information.

There is no question, of course, that this unrelenting effort is slowly enlarging the accumulated understanding of pertinent relations and conditions, and if oil is there in substantial quantity, the persistent search will inevitably be rewarded. It is pointed out by the Imperial Oil Review that "of approximately 1600 holes drilled in western Canada to date, less than a dozen can definitely be accepted as having been drilled deep enough to test all the possibilities of the sedimentary deposits." On this basis, the scarcity of results in terms of actual production from western exploration is not regarded as completely discouraging by any means. Western Canada is believed to be comparable structurally, and with respect to its oil producing possibilities, to Montana, Wyoming, the Dakotas, Colorado, Iowa, and Nebraska. These states have been much more fully explored than has the Canadian area under discussion, and have an ultimate yield estimated at about a billion and a half barrels.



Single



Dual

Triple

Pressure Control Is Our Business

O-C-T

Whatever Your Completion Needs May Be... O-C-T Has the Tree

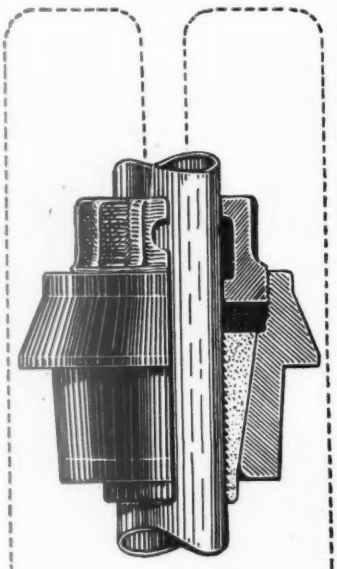
For single, dual and triple completions, Oil Center has the "know how" and the *right* equipment for the job. Experience gained from thousands of well completions throughout the world is reflected in the modern well completion tools which bear the O-C-T name: Valves, well heads, chokes, fittings, blowout preventers, and others.

OIL CENTER TOOL COMPANY

HOUSTON

Export: Val R. Wittich, 30 Rockefeller Plaza, New York 20, N. Y.

ASSOCIATION OF WELL HEAD EQUIPMENT MANUFACTURERS CERTIFIED



TUBING HANGER

Fully Patented

PLAY SAFE

ASK FOR

HERCULES

Hercules Tubing Hanger insures absolute safety . . . eliminates the hazard of dropping tubing caused by pinched off collars, rigs burning or blowing down, or by other accidents. Hercules saves time . . . to repack you do not have to lift tubing, disconnect well or interfere with pumping operation. Packing is above slips, distorted by means of a screw-threaded nut. Hercules has few parts . . . is easy to install. Made to fit 4½" OD to 10¾" OD Berry Pattern Casing Heads and for 2", 2½" and 3" tubing.

Sold at all supply stores.

HERCULES
TOOL COMPANY
TULSA, OKLAHOMA, Box 286
EXPORT OFFICE: 30 Rockefeller Plaza
NEW YORK, U.S.A.
CABLE ADDRESS: HERTOCO

Canada is optimistic about her oil future and, conscious of the urgent need for further reserves, is spending much time, effort, and capital on the oil search, despite its high cost. Imperial Oil Limited has been very progressive in this respect, and in its vigorous campaign to develop Canada's oil resources has made heavy expenditures. Often considerable initial outlay for geological and geophysical surveys is required before drilling is begun, and when the decision to drill is reached, the equipment needed to penetrate to great depths is expensive. This company drilled a dry hole at Coalspur that was carried to a depth of 12,955 ft., and cost approximately $800,000. Turner Valley wells run from 7,000 to 9,000 ft. deep, cost not less than $150,000 each to drill, and many of them, although producing, will never pay off the original cost. As a part of the exploratory search, Imperial Oil and Shell Oil of Canada jointly drilled a deep test near Stolberg, Alberta. This well, known as Imperial-Shell-Stolberg No. 1 is Canada's second deepest. It was drilled to 13,747 ft. and plugged back to 12,856 ft. for a test.

Between 1939 and the end of 1945, Imperial Oil Limited spent for exploration approximately $5,800,000 in Alberta; $3,000,000 in Saskatchewan, and exclusive of the Canol project, $2,500,000 in the Northwest Territories. That is a lot of money that must be backed by a lot of faith, and a lot of courage, because actually, returns to date have been small. There has, however, been no apparent decline in the hope curve, because the program is to continue this progressive search undiminished on a national scale, and seek by every orderly means to develop the petroleum resources of the Dominion. In the present state of social and economic development, the importance of a self-sustaining domestic supply of petroleum is so great, that any exploration effort having a fair chance of success is justifiable. Today, Canada is an immense area, sparsely populated, with tremendous natural resources that will some day be much more fully explored and exploited. How quickly its population will grow and its industry be expanded to their full vigor and scope, will depend to a large extent on the question of petroleum supply. Industrial leaders realize this fact, hence, the persistent, though expensive, program of study and research, directed toward the solution of a highly vital national problem.

Particulaly interesting in any treatment of Canada's situation with respect to reserves is the Canol project—a wartime development, the merits or demerits of which will not be discussed here. Suffice it to say that when the project was first broached, the Japanese were firmly, if not comfortably entrenched in the Aleutians, and constituted a serious threat to Alaska, and thence to the remainder of the North American continent. In any case, it was Steffanson, the explorer, who first drew the attention of the United States to the small oil field at Norman Wells, discovered and developed by Imperial Oil Limited, that might be expanded into a significant war asset. There was, at that time, a distinct danger that the Japanese would make it rough for tankers plying the outside route to Alaska, always providing that any tankers could be spared for this service, and a more immediate source of supply was required for refueling war planes engaged in the Aleutian campaign, and bombers being ferried to Russia.

It was contended that the field could be quickly expanded to produce 3000 bbl. a day, and this was the objective when the project was begun on May 1, 1942, with Imperial Oil Limited in charge of drilling and production. On July 4, 1942, drilling was started, and by the end of the year 16 wells had been completed, of which two were unsuccessful. When operations were halted on May 8, 1945, 67 wells had been drilled—60 commercially productive, and 7 dry holes. Most of the latter were some distance from the proved area and were in reality wildcats. However, the active wells produced a total in excess of 4000 bbl. a day for the last six months of operation, so that the original objective was passed by a considerable margin.

The situation in eastern Canada remains substantially unchanged. Some of the oldest fields on the American continent are in Ontario, which is the sole producing province in the east except for a very small production in New Brunswick. Oil Springs and Petrolia fields were discovered in the early sixties, and are still the highest producers in the area. In the Ontario fields at the end of 1945, there were approximately 1500 wells yielding an annual increment of 113,324 bbl., about a 10 per cent decline from the preceding year. Out of a total of 15 wildcats drilled in 1945 in Ontario, Imperial Oil Limited was responsible for twelve. They were all dry, incidentally, so that they added nothing to the reserves, although they undoubtedly did add to that accumulation of data, which is gradually taking the uncertainty out of the situation, and will one day enable the operators to reach much more positive conclusions with regard to petroleum prospects.

In the Maritime provinces some 125 wildcat wells have explored widely scattered areas in Nova Scotia, New Brunswick, Prince Edward Island and the Gaspe peninsula of Quebec, where sedimentary rocks with petroleum antecedent are present.

So far the only production is from New Brunswick where a little oil is recovered from a field largely devoted to the production of natural gas; but the search has resulted in the drilling of Canada's deepest test, a well drilled off shore at Hillsboro, Prince Edward Island, going to a depth of 14,686 ft. without success.

In any event, it is certain that while there is still a possibility to be explored, Canada will go on testing, for moderately priced oil or a comparable substitute is distinctly necessary to the healthy economic growth of our northern neighbor. ★★★

Geophysical operations in Kuwait*

By **P. H. BOOTS**† and **ALEXANDER H. McKEE**‡

Abstract. This paper describes the general operations of the combined geophysical party, using gravity, magnetic and seismic methods, which made a survey of Kuwait in one working season. The organization of the party, the general conditions met, and the manner in which the operations were adapted to the country and its people are described. The geophysical results themselves are not included, but it may be remarked that the surveys described led to the discovery of one of the great oil fields of the world.

● **Introduction.** This article describes a survey that was made of Kuwait (in the Persian Gulf area) in a successful search for oil. The methods applied to the search in Kuwait are equally applicable to the major portion of the Near and Middle East with results that may quickly and economically disclose the prospects of the area. No new methods will have to be developed for such a search. The tools that have been tried and proven in this country in the past few years are adequate for the job.

It is hoped that this review of the survey of Kuwait will serve to illustrate how a well-rounded geophysical attack, using the rapidly moving gravimeter and magnetometer for reconnaissance, followed by seismograph work in selected areas, and with competent and close geological cooperation, can give immediate and positive results in an entirely new area.

● **Location, topography, and climate.** Kuwait lies at the northern end of the Persian Gulf at Latitude 29°N. between Iraq to the north and Saudi Arabia to the south and west. The eastern boundary of Kuwait is formed for 145 kilometers by the Persian Gulf. The area of the country is 12,250 square kilometers or about 4730 square miles. It is ruled by the Sheikh of Kuwait, Sir Achmed ibn Jabur as Subah.

The topography of Kuwait generally is of low relief. From the Persian Gulf shoreline, the land rises gently to the westward to an altitude of 280 meters. Forming the western boundary is an abrupt break, a long narrow trough about 5 kilometers wide and 100 meters deep known as Al Batin. The maximum depth of Kuwait Bay is fifteen fathoms and large areas are exposed at low tide. From Kuwait Bay south, the shore line is closely paralleled by a ridge, Al Tha'ar, of about 100 meters relief.

There are no permanent streams in Kuwait. The low hills are separated by wide, shallow, and sandy watercourses, dry except during an exceedingly rare heavy shower. Large areas in the northern and western parts of the country are covered by typical aeolian gravel. These areas are excellent for car and truck travel and, over them, it is possible to drive unhindered in any direction. Other areas have a low sagebrush-like perennial called camel thorn. Around the base of this bush, sand collects in hummocks, which slows truck travel exceedingly.

The climate is controlled by winds that have had all the water wrung out of them in their long sweep across Asia before they reach Kuwait. It is hot and dry in the summer and generally dry and cool in the winter. The humidity is very low except for a few days in the winter and spring. There is a daily temperature range of 20 to 25 degrees. The annual maximum and minimum are about 125° F. and 30° F. Both the daily and annual cycles of temperature are quite regular. (Fig. 1). There are rather strong winds at random times throughout the year but, in the early summer, extreme winds blow for days, generally from the north. Once or twice during January, the temperature drops low enough to form a thin layer of ice in the camp water pans.

An annual precipitation of about 4 in. usually falls in a few heavy showers (sometimes accompanied by much lightning) in the winter. After one of these rains, the desert is very muddy for a few hours and the normally dry watercourses give the appearance of having been raging torrents at the height of the storm. During the summer there are days and weeks when there is not a cloud in the sky. Then the sun temperatures are extreme and the days are very monotonous. Thus, late fall, winter, and early spring provide pleasant working conditions, but the same cannot be said for the rest of the year.

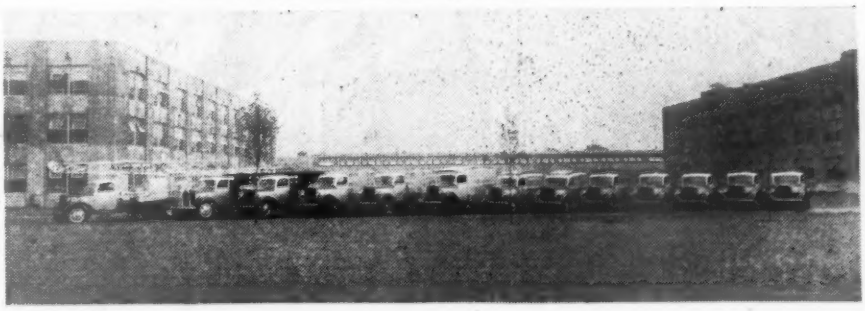
● **People and customs.** Kuwait has a population variously estimated from 50,000 to 75,000. Probably 90 per cent of the people live in the walled city of Kuwait located on the south shore of Kuwait Bay. Modern improvements and conveniences have not yet infiltrated. The town has no water system whatever and, consequently, no sewage system. It does have an electric plant and a limited distribution system, but it is in operation only a few hours out of the twenty-four. No hotel is available for the visitor from the Occidental world. Streets are narrow and, in most cases, have just enough clearance for the occasional automobile that drives through them.

The lack of an adequate local water supply makes the town dependent upon water shipped 60 miles by sailboat from the Shatt-el-Arab, the river formed by the confluence of the Tigris and Euphrates in lower Mesopotamia, and distributed through the town on the backs of donkeys.

There are several small oases near the coast which depend on well water and manage to irrigate vegetable and date gardens from this source. These oasis wells are large pits 15 ft. square and 25 to 40 ft. deep employing goat-skins and donkey power combined in an ingenious manner to lift the water to the surface. It is rumored that an American-type windmill once graced an oasis well, but it had fallen into disrepair and disuse. No trace remained.

A few hundred people live in oases. A varying number of Bedouins (nomadic sheep and camel herders) populate the desert hinterlands. These people migrate with their flocks to follow pasturage. In the winter, the flocks are driven far from the wells to allow the grass to grow there. As the hot weather approaches and the animals must be watered more often,

Motor equipment for Kuwait survey, as assembled at Gulf Research Laboratories, for shipment to Kuwait.

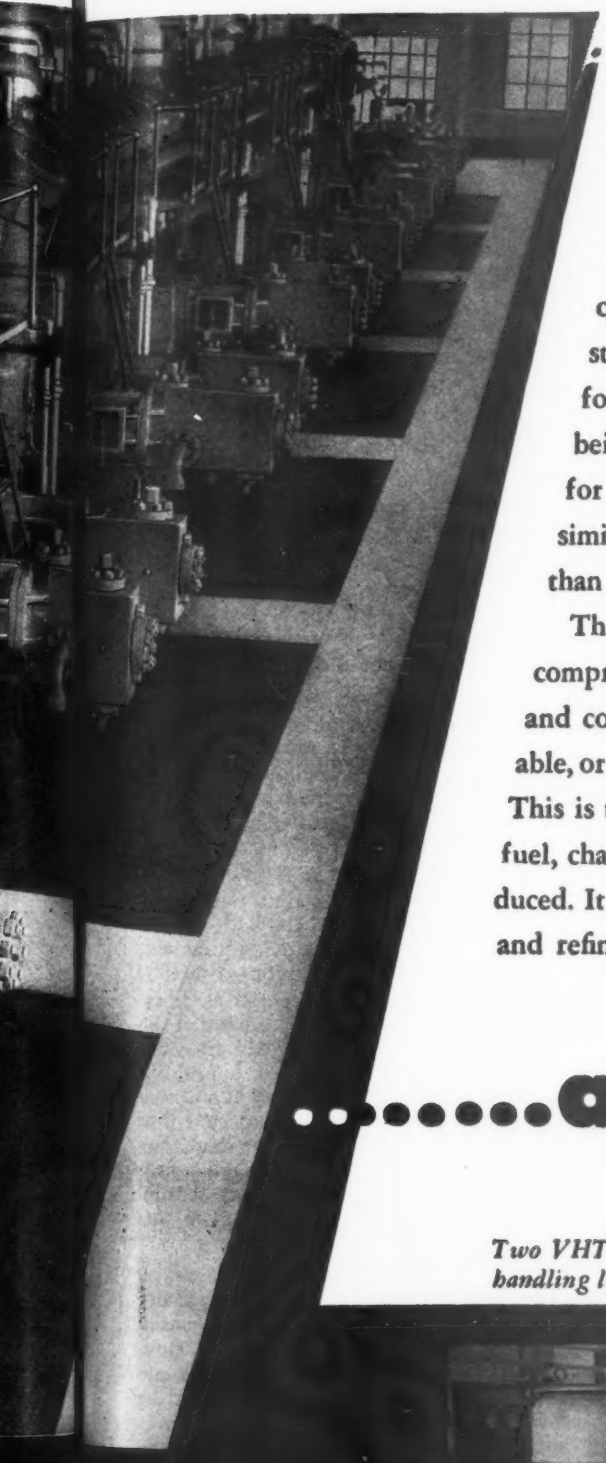


*Presented before The Society of Exploration Geophysicists, Dallas, Texas, March 21, 1944. Published in *Geophysics*, April, 1946.

†Chief Geologist, Colombian Gulf Oil Co.
‡Gulf Research & Development Company, Pittsburgh, Pa.

at KATY...
The 4-CYCLE
V-ANGLE Line
SEVENTY-FIFTH
ANNIVERSARY

....THE WORLD'S LARGEST CYCLING PLANT



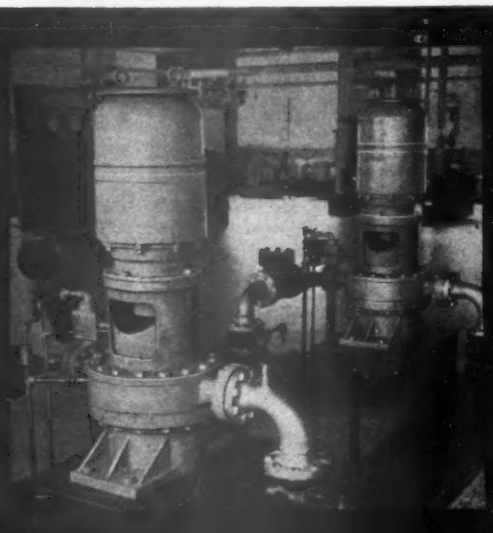
With a capacity for processing some 500 million cu ft of natural gas per day, and facilities for re-injecting nearly 400 million cu ft at high pressures, the "group-owned" Katy Plant (Katy, Texas) is the World's largest gas-recycling unit.

There you will find the 5600-hp battery of gas-engine-driven main cycling compressors shown here. These are 800-hp, Type KVG single-stage units which compress the gas, after processing, to about 3150 psi for re-injection into the oil sands. Two more 800-hp KVG units are being installed at the end of the line to boost flash gas into a pipe line for sale. A 300-hp Type XVG compressor already installed serves a similar purpose. This makes a total of 7500 hp of 4-cycle V-angles—more than half the total compressor capacity at Katy.

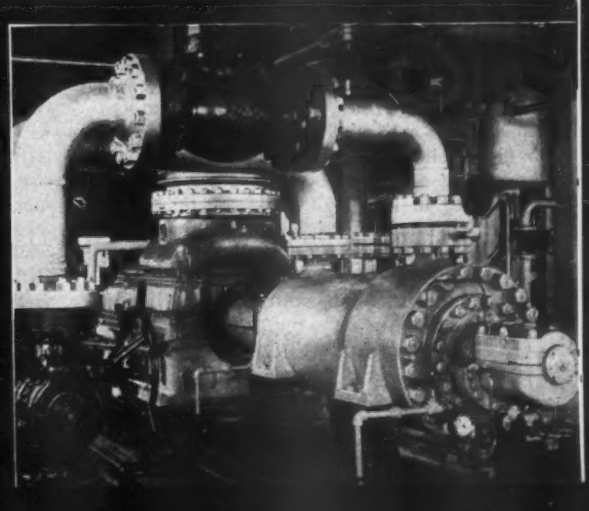
The outstanding advantages of the Ingersoll-Rand 4-cycle V-angle compressors are *dependability* and *economy* . . . whether the load is heavy and continuous, or changeable . . . whether the pressures are steady, variable, or surging . . . and whether the required speed is constant or fluctuating. This is true at Katy, where high-octane gasoline, heavy naphtha for motor fuel, charging stock for toluene, and butanes for synthetic rubber are produced. It is also true in gas-lift, cycling, repressuring, and pipe-line systems, and refineries throughout the world.

.....and I-R PUMPS

Two VHT 6-stage vertical pumps handling lean oil to the absorbers.



One of three CHT 9-stage lean-oil pumps.



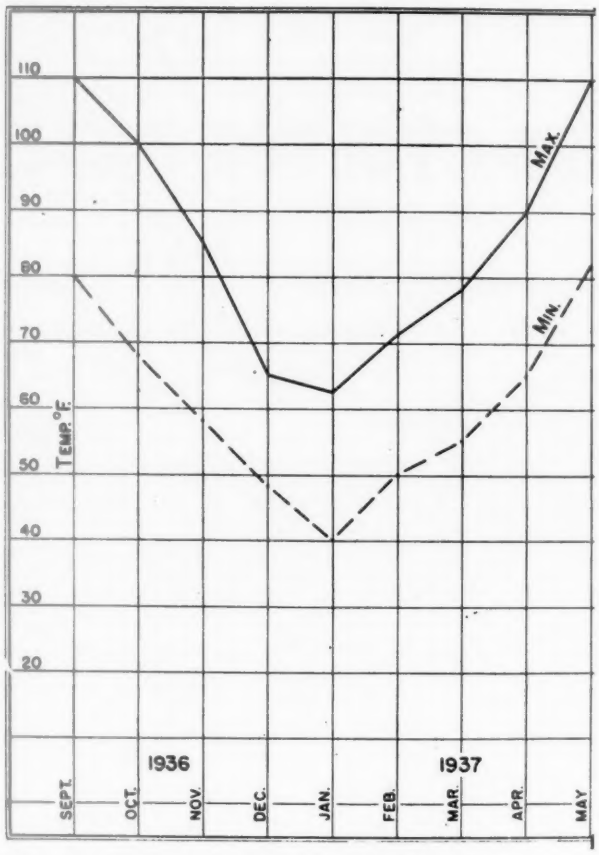


FIG. 1. Average shade temperature in Kuwait.

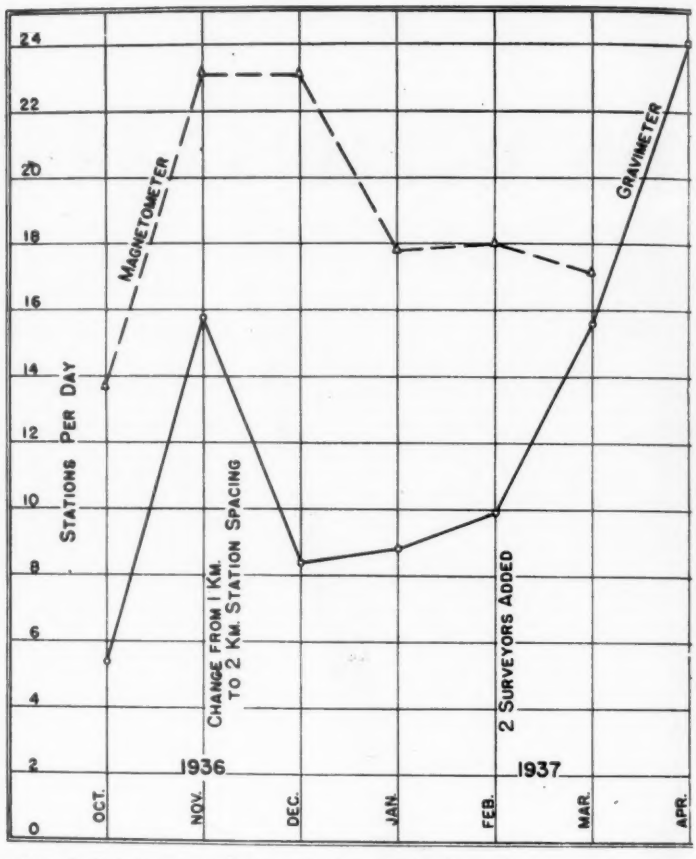


FIG. 2. Stations per day per instrument—Kuwait.

the flocks come closer and closer to the wells and the dried grass near them is used for pasture. The pasture does not follow national boundaries and neither do the Bedouins. This seasonal wandering of the Bedouins follows certain patterns dictated by weather and by customs hundred of years old. Thus, there may be several thousand Bedouins in Kuwait at some seasons, at other times almost none. For the most part, they are quite friendly and hospitable, sometimes inviting one to partake of coffee at their nearby tent.

● **Purpose and organization of geophysical party.** The interest in Kuwait from the point of view of petroleum was probably initiated by two or three small oil seeps in the country. The Sheikh of Kuwait granted a concession of the oil rights of the country to the Kuwait Oil Company, Ltd., in 1934. A geological survey of the area was made, but little surface evidence of structure was observed. The problem was that of assessing the possibilities of the country. Little was known of the geologic section. The nearest oil wells were in Iraq, Iran, and at Bahrein, none of them close enough to disclose the section in Kuwait. It was decided to drill a test hole on the limited surface evidence of structure that had been observed north of Kuwait Bay and at the same time make a geophysical survey of the country. If the hole were dry, it would at least disclose the section. If the hole made an oil well, the geophysical survey should disclose the extent of the structure on which the well was drilled. The test, Bahrah No. 1, was begun in 1936.

Because of the remoteness and inaccessibility of Kuwait, it was decided that the country should be covered by some kind of reconnaissance geophysical survey in one working season, which was judged to extend from September through May. As there was no advance way of knowing what methods would work best in Kuwait, it was decided to make the geophysical party as versatile as possible so that the maximum results might be gained from the effort expended. The party was to be equipped to do gravity, magnetic, and seismic work.

Three magnetometers were assigned to the party. These were Schmidt vertical balances that had been used for some time in work in this country and South America. One of these instruments was to be used as a base instrument, one as a field instrument, and the third as a spare.

Two standard Gulf gravimeters[1] were allotted as gravity field instruments. Small portable gasoline powered generators were used to charge the batteries for maintaining temperature control of these instruments.

Standard seismograph equipment adapable to doing either reflection or refraction work was mounted in a truck with a false roof, thus affording the operator additional protection from the sun. The drill for seismic shot holes was made up to special specifications and was much heavier than normal so that it could be used also for drilling 800 or 900 ft. holes for water wells or for core drill tests.

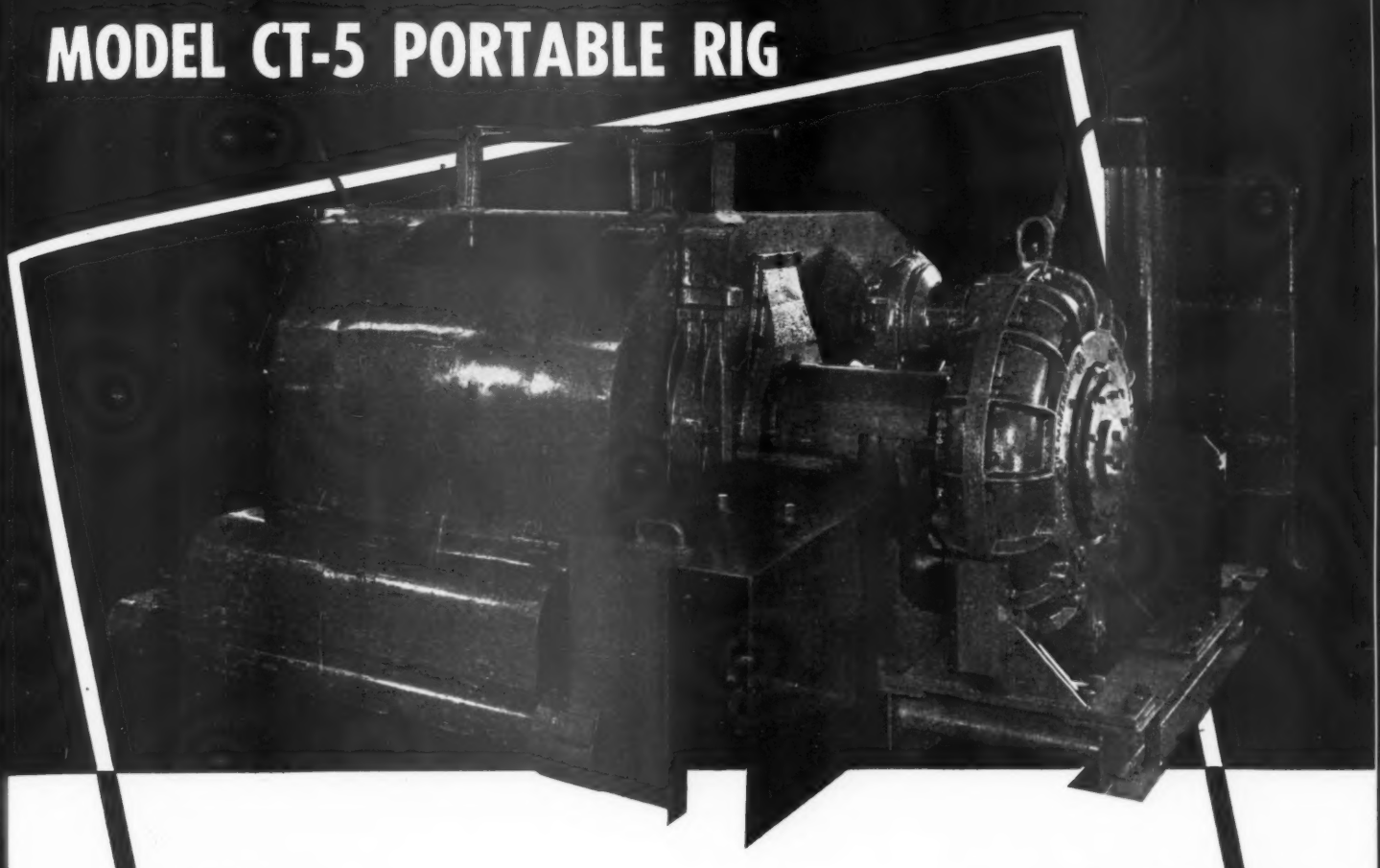
All automotive equipment was of one make and all trucks were held to two models, with the exception of the drill chassis, to simplify repair problems. All units were equipped with oversize wheels and tires because part of the area had been reported to be quite sandy.

Spare parts to cover almost any eventuality were assembled for both the automotive and geophysical equipment. This spare assembly was based on former foreign working experience. Shipping time to Kuwait was so great that the breakdown of a really critical part could shut down a unit long enough to prohibit the completion of the survey in one season. Although it was not expected that all of the spare parts would be used, they were looked on as insurance against failure to complete the survey in one season. A complete automotive repair shop was included.

The personnel of the party was selected with the idea that both the gravity and magnetic methods would not be used as reconnaissance over the entire country. Both were to be tried, then the one that showed the more promise would be used to complete the survey. It was fairly certain that the seismograph would be used because it is a rare area that will not yield some information to either the reflection or refraction methods of survey. The men for the party were accordingly selected with the idea that they would have to be able to use more than one kind of instrument. Also, the men were so selected that if any given man became ill or had to leave the country,

[1] R. D. Wycoff, *The Gulf Gravimeter, Geophysics*, 6, No. 1 (Jan. 1941), pp. 13-33.

MODEL CT-5 PORTABLE RIG



with ONE ENGINE . . . TWO ENGINES or THREE ENGINES . . . you can take your choice when you order your CT-5 PORTABLE RIG

WITH ONE ENGINE—you have an excellent deep well workover rig that can also be used for shallow drilling. Low cost and practicability are features that make this combination a favorite.

WITH TWO ENGINES—you have a top notch 6500-foot drilling rig that does a fast, efficient job. Ruggedness, portability and easy control are features that make this combination so well liked.

WITH THREE ENGINES—you get an extra flexibility that assures fast, uninterrupted drilling. This drive arrangement is becoming increasingly popular.

ANY WAY YOU ORDER—you are sure of getting a "best buy" for your purposes. The popularity of this rig with oil companies and drilling contractors is your assurance of serviceability. Get full details before you buy any rig.

NEW CATALOG!

The new T.I.W. catalog is ready. It describes in detail the complete line of T.I.W. products. Ask your T.I.W. representative for one, or write us direct. We will send you one by return mail.

TEXAS IRON WORKS

MANUFACTURERS OF: T.I.W. Portable rigs . . . T.I.W. Safety Joints . . . T.I.W. Rotary and Casing Slips . . . . T.I.W. Grief Stem Safety Valves . . . T.I.W. Packers for every purpose . . . and many other oil field tools.

TIW

GENERAL OFFICE and MAIN PLANT: 1401-1423 Maury Street, Houston 10, Texas.

Other Shops at Victoria and Corpus Christi.

EXPORT REPRESENTATIVE: Val R. Wittich, 30 Rockefeller Plaza, New York, N. Y.

he could immediately be replaced by another man so that the work could go on. The personnel of the party was

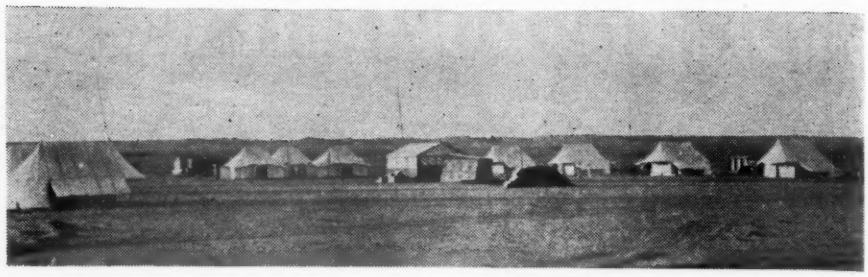
2 magnetometer operators
2 gravimeter operators
1 seismic interpreter
1 seismic observer
1 driller
1 shooter
1 draftsman
4 surveyors
1 mechanic-driller
1 party chief

The camp equipment such as tents for living quarters, kitchens, offices, and so forth, was supplied by the local operating company. The office and kitchens were wood buildings made in sections so that they could be quickly dismantled and transported from campsite to campsite on a ton-and-a-half truck. The living quarters were 12-ft. by 16-ft. tents (made in India) of several thicknesses of thin cotton cloth. Doors and window flaps in these tents served to make them as wind and dustproof as tents can be. For desert use they were superior to any tents seen in this country, but would be unsuitable for use in tropical countries where the humidity is high.

The camp was supplied with electricity by a 1½-kw., 110-volt d-c. gasoline-driven generator. The kitchens were furnished with kerosine operated refrigerators. A shower room was constructed complete with hot and cold running water. The water came from two large drums supported overhead and, in cooler weather, charcoal burning in a central flue in one of the drums provided the hot water. These modern conveniences added much to desert living. The camp personnel consisted of Indian cooks and mess boys with natives for general camp chores.

● **General methods of operation.** Prior to the geophysical survey, no ground survey had ever been made of Kuwait. Thus, the party had the opportunity of starting from scratch. An approximate outline of the country was available and a former British Political Agent had made a reconnaissance sketch showing the most prominent land features and place names. The British Admiralty had a hydrographic survey of Kuwait Bay and its approaches. The surveying problem in Kuwait called for the establishment of primary control, laying out seismograph control, locating and leveling gravity stations, and locating magnetic stations within the basic primary control.

The primary control was established with a reasonably precise transit by triangulation from a carefully chained base line. The drilling well, Bahrah No. 1, was utilized as the origin of the metric coordinate system which was adopted for the work. Triangulation stations were established on prominent landmarks and at convenient intervals throughout the country. These triangulation points were kept to an accuracy of not less than one in five thousand which was considered sufficiently precise for any work the oil company might wish to do. Seismic profiles were tied to the triangulation net by chained lines. Seismic elevations were run using transit vertical angles in trigonometric leveling.



General view of geophysical camp.

Gravity and magnetic stations were located by plane table using triangulation or stadia traverse methods. These stations were located in a regular square array on the metric grid. The plane table operator would establish a corner on this grid from the primary control, orient himself and measure by speedometer (all vehicles had metric speedometers) the distance to the next station location. By observation on signals on primary control points, he would cut in his location and make a stadia shot to the station position. In this way, the plane table work was seldom carried long distances without benefit of primary control.

In that monotonous landscape, the absence of any prominent points on the horizon makes it difficult to drive a car in a straight line. After some experimentation, improvised sundials were mounted on the car radiators and used as sun compasses. By watching the shadow on the dial and keeping it properly oriented, one was able to maintain a reasonably straight course in any desired direction.

The levels for the gravity stations were carried with Y-levels in the usual manner. All stations were on closed traverses and a closure of 10 cm. or less was demanded on all loops. Sea level was established by a short series of observations on high and low tide marks. This was not an accurate determination because the level of the Persian Gulf depends to a great extent on the direction of the wind. However, this is an unimportant point because an error in the datum plane does not affect the validity of the results of the geophysical survey. A by-product of this survey of Kuwait was a topographic map of the country accurate within the limits of the density of the elevation control.

● **Gravimeter and magnetometer operations.** The geophysical party and its equipment landed in Kuwait in the middle of September, 1936, during very hot weather. Equipment and supplies were taken off ship and the equipment uncrated, assembled, and tested in the following two weeks. Also, Arab labor was hired; truck drivers were tested for their ability. Some interpreters were acquired in an effort to overcome language differences.

Gravity, magnetic, and seismic work was all started at the drilling well, Bahrah No. 1, on October 1, 1936. The gravity and magnetic work was started with station spacing of 1 kilometer on a rectangular grid. This spacing was of an experimental nature because the size of the anomaly to be expected was not known. After about 900 square kilometers had been worked, it became apparent that the gravity and magnetic pictures were sufficiently regular that the station spacing could be doubled without missing any essential features. Furthermore, from the rate of progress, it had become apparent that the country could not be covered in one season with either instrument with a 1 kilometer spacing; however, this was a secondary consideration in opening up the spacing. Early in December, the spacing was increased to 2 kilometers and held there for the remainder of the survey with the exception of selected areas where closer spacing was used to check results.

A two months' trial of the two kilometer spacing showed that both the magnetometer and gravimeter could not cover the entire country in the remainder of the working season. An inspection of the results from both methods also showed that the gravity was probably giving the more information of the two methods, although both were yielding gratifying results. Magnetometer work was then abandoned and the released personnel added to the gravity survey. Unfortunately, at this time, one of the gravimeter operators became ill and had to return to the States. Two additional surveyors were hastily sent from the States to help with the location and leveling of gravity stations to assure completion of the survey.

Fig. 2 shows the rate of progress of the gravity and magnetic work. It will be noted that the number of magnetic stations taken per day was relatively constant throughout the survey, whereas the number of gravity stations occupied per day tended to increase throughout the survey. The explanation is that the magnetometer is essentially a one-man instrument, and the operator was already experienced when the survey began. He was able to occupy stations at a fairly constant rate once the survey was under way.

Each gravimeter required two men for its operation, one American and his Arab helper. It took more than a month to train this helper in his duties. At the end of the second month, the gravimeter could occupy more stations than the surveyors could furnish, as the surveyors were also training green men at the same time and their training was more difficult than that of the gravimeter helper. In November, three times as many stations

were occupied as in October, the first month of the survey. In December, the rate dropped back to about one-half of the November rate which reflects the change in station spacing from one to two kilometers. For three months, there is a slight increase in the curve which reflects the added training of the surveying crews. In February, three surveyors were added to the gravity staff. The rate then rises steeply through March and April, reflecting the training of the new crews, who incidentally, learned faster than the original crews because experienced Arabs were seeded with the new men and language difficulties were eliminated to a great extent.

This graph indicates that the gravity survey was just hitting its true stride when the job was completed. This is about the training period that might be expected in an operation of this kind. An experienced party with two gravimeters should be able to occupy about 1500 stations per month in a country like Kuwait. In all 2257 magnetic streets and 4442 gravity stations were observed in Kuwait.

● **Seismograph operations.** The first two weeks after seismograph work was begun in Kuwait on October 1, 1936, were spent in testing instruments, in experimental shooting, trying different setups, measuring near-surface velocities, shooting short refraction lines to gain an idea of the sub-surface velocities, and determinations of the optimum depth for shot holes. After three months of rather slow work around the drilling well, during which time Arab drilling and recording crews were learning their duties, the location of Bahrah No. 1, looked unfavorable from a geophysical standpoint. The seismograph activities were then transferred to an area south of Kuwait Bay that looked anomalous from the results of some 400 gravity stations that had been observed there. Bahrah No. 1 subsequently proved to be dry.

Four months seismic work was completed south of Kuwait Bay. The shooting was slow because of the difficulty experienced in drilling shot holes even with the heavy drill employed. Nevertheless, a structural area of interest was outlined and detailed sufficiently to secure a satisfactory drilling location. This location, Burgan No. 1, was subsequently drilled in as the discovery well of the Kuwait field.

It should be stressed that the interpretation of the whole survey of Kuwait was aided by the resident geologist who was not only well acquainted with the geology of the Persian Gulf Region, but also well versed in geophysical methods. He was in weekly and sometimes daily contact with the party. In this way, interesting results could be sympathetically discussed and acted upon as they were mapped. This cooperation avoided the lost motion that often develops in foreign work where results sometimes spend weeks in the mail before they can be discussed from the geologist's point of view.

● **Cooperation with native help and customs.** In making a survey of the kind that was done in Kuwait, a number of native workmen must be employed. The Arab workers employed in Kuwait were willing, honest workmen. The standard of living in the country has been quite uniformly low with a consequence that there is practically no mechanization. Recently, some cars have come into the country, but there has been no transition from camel driving to car driving. The result is that the people have no mechanical background, but much of this lack of background is made up by willingness. The Arabs are natively intelligent, but one cannot expect a man who has never put a nut on a bolt to become a mechanic overnight. The combination of willingness and mechanical naivete did produce a number of exasperating situations until one thought about the background of the people. As an example, a surveyor running levels would send his rodman out for a foresight and the rodman would keep right on going over the next hill. The reasoning was that the surveyor with his remarkable telescope should be able to see the rodman anyhow.

A tribute to the ability of these people to learn is that at the end of six months the crew operated with satisfactory efficiency. At the end of eight months, the party was turning out work at a rate that would test a good many crews in this country.

The absolute honesty of the people of Kuwait should be mentioned. The Sheikh of Kuwait has an excellent knowledge of what is going on in his country. If there is a suspicion that any one has stolen anything, howsoever small, the offender finds out immediately that honesty does pay. The result was that not only could you lose nothing, you also could throw away nothing. Workmen were exceptionally careful about tools, nothing was lost through carelessness.

All of the people of Kuwait are Mohammedans. There was no friction caused by religious differences. Instead of being fanatical as travel books might suggest, the people were tolerant of the Occidentals. After all, the party was introducing foreign customs into a country that had enjoyed its own customs for centuries. For the most part, the party observed all of the Mohammedan feast days to the exclusion of the Western holidays. Christmas was the exception.

Another outstanding trait of the people was their hospitality. Often the surveyors would come across a Bedouin who would wave them down to ask them to come to his tent for a cup of coffee. The fact that the coffee was vigorously boiled probably compensated for the doubtful origin and purity of the water.

The major difficulty encountered in the country was that of language. It was difficult for the Americans to learn more than a few Arabic words, but the Arab workmen learned a basic English rapidly. The Arabic language is extremely perplexing in its grammar, pronunciation, and vocabulary. An entirely strange alphabet makes the written language forbidding.

One operating difficulty involved survey stakes. There is no wood in the country and every bit is valuable. The Bedouins would find the stakes, apparently loose in the desert, and would pull them up. After a few hundred had disappeared, the Sheikh of Kuwait sent word among the Bedouins that the stakes should not be disturbed. The survey stake situation then improved.

The Arabs customarily dress in long, flowing robes that are dangerous around machines. There is some reluctance on their part to change to trousers or shorts on a safety basis as they are inclined to be complete fatalists.

The employees were entirely made up of "city men." The desert Arabs, the Bedouins, will not accept work. The inborn sense of direction attributed to Arabs in travel books does not exist for the city Arabs. They would get completely lost the minute they were out of sight of town. However, the Bedouins actually do know their way about the desert. They have every landmark named and can find their way from one place to any other.

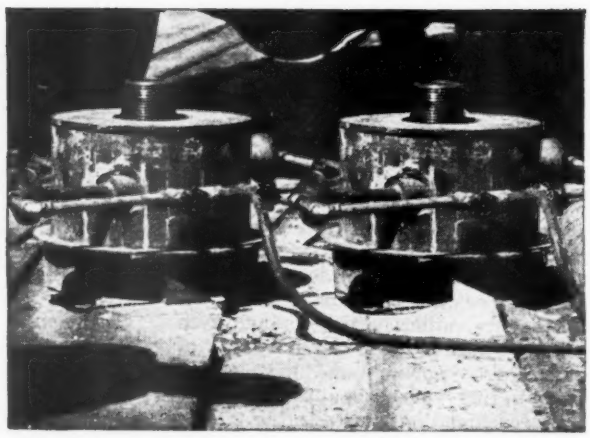
In working in the desert, the health of the party is of prime importance. A doctor was available from the local American-supported mission. The Middle East is host to a number of diseases that are rare in this country. Trachoma is common among the Arabs, although foreigners seldom seem to get it. Dysentery is widespread. Leishmaniasis which causes troublesome ulcers on the extremities is transmitted by sand flies and is common. During certain seasons, there is an unbelievable number of flies that resemble the common housefly. One can drive twenty miles into the desert without seeing life of any kind, open his lunch, and have it covered with flies before he can get a bite into his mouth. These flies transmit amoebic dysentery. Standards of sanitation must be kept very strict around a camp. The ordinary elements of an American diet are lacking in Kuwait. Mutton, fish, rice, and dates are about the only plentiful articles in the bazaars. Other items must be imported. The change in diet from fresh to canned foods often affects men new to the country.

● **Suggested improvements.** The experience gained in this survey would indicate that well screened trailers would be better living quarters than tents. They could be heated in winter and they could be made flyproof. In wet weather, trailers keep men off the ground after a hard day's work. The efficiency of a party depends so much on its morale and health that too much cannot be done in this direction. A man's morale is helped if, at the end of a day's work, he does not have to contend with cold, dust, flies, or rain. This is particularly true where a party is isolated for a number of months without much change of scene.

Another change that experience would indicate is that the automotive equipment should be all-wheel drive whether the units are four or six wheel units. The added mechanical difficulties will be more than compensated by the better transportation. ★★★

SIMPLICITY

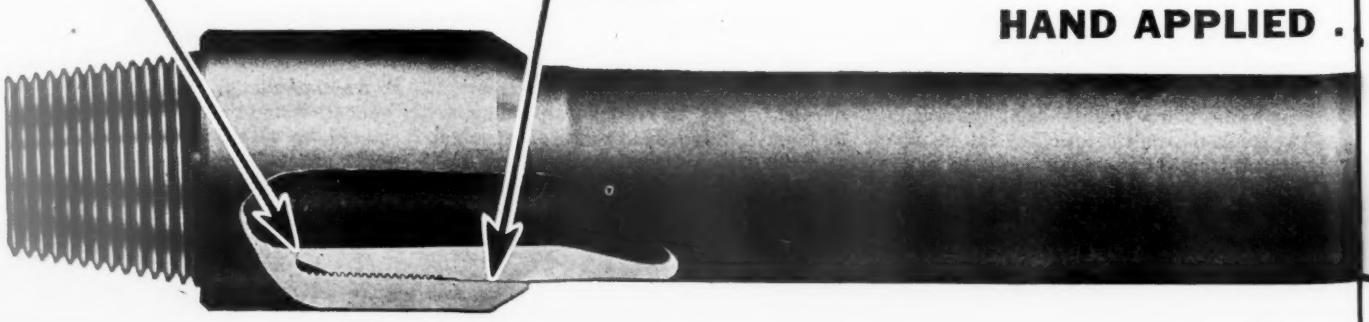
HEAT THE TOOL JOINT



...and your drill stem

THE END OF THE PIPE IS "SHRUNK-ON" TIGHT AGAINST THE SHOULDER STOP IN THE TOOL JOINT

THE SHRINK-GRIP *"SAFETY AREA"* SEALS AGAINST LEAKAGE AND SUPPORTS THE DRILL PIPE AGAINST BREAKAGE AT THE LAST ENGAGED THREAD.



REED

HAND APPLIED

PERSONIFIED

SCREW THE TOOL JOINT ON ... BY HAND

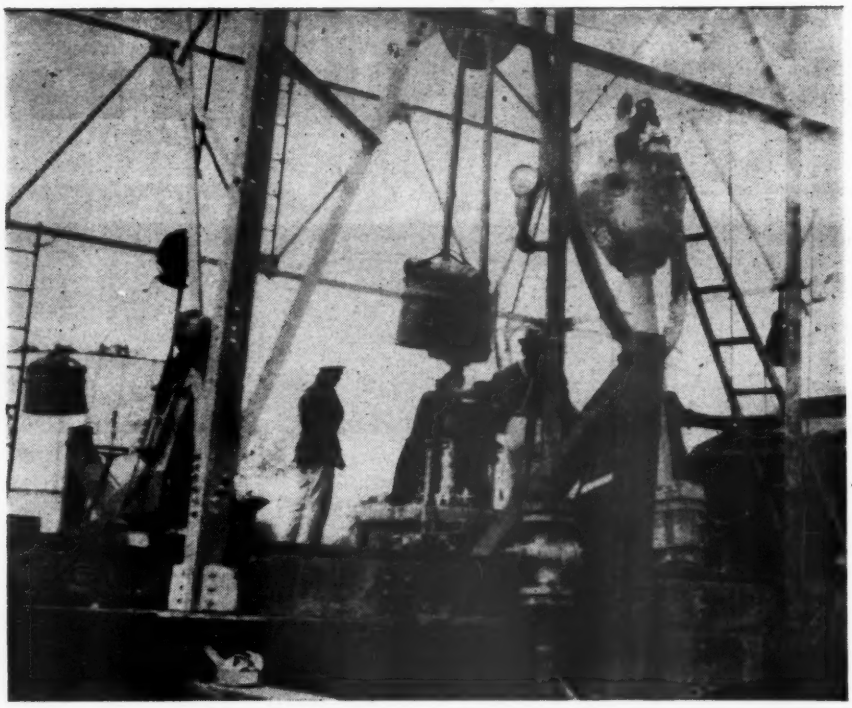
is ready for drilling

Super Shrink-Grip TOOL JOINTS

... AND NO GAUGING OR SELECTIVE FITTING REQUIRED

Reed ROLLER BIT COMPANY

HOUSTON 1, TEXAS



General view of Santa Rosa No. 1 during the spudding process that took place July 15 in an interesting ceremony in the Paraguayan Chaco

Union explores Paraguayan Chaco

By **RICHARD SNEDDON,** *Pacific Coast Editor*

So far, Paraguay has produced no oil, but if it has a productive sand anywhere within the present reach of a drilling bit, that situation may soon be changed, for the Nation's first well, Santa Rosa No. 1 is now well below 4000 ft., and drilling ahead. It was spudded on July 15, 1946, at a dedicatory ceremonial that created great excitement in the area, and was attended by a number of Paraguayan dignitaries, including Captain Ramon Martino, Minister of Public Works and Communications; General Andino, Military Commandant and Administrator of the Chaco, and Colonel Guggiari, his Chief of Staff; Senor Victor Pane, Minister of Finance, and Mr. Willard Beaulac, American Ambassador to Paraguay. Also present were A. C. Rubel, vice president of Union Oil Company, and Earl B. Noble, manager of exploration for Union, and president of the American Association of Petroleum Geologists, among others.

EXCLUSIVE

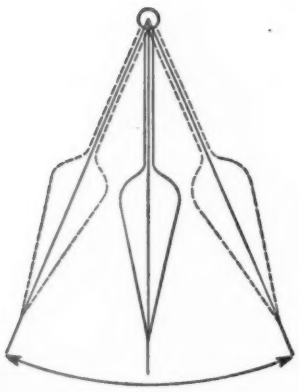
It is interesting in connection with the spudding, that the well was spudded and the first 30 ft. of the hole drilled by Minister Martino, who handled the controls capably. In recognition of his completely satisfactory performance, indeed, he was subsequently presented with a check having the customary deduction as a memento of the occasion. The occasion was a historic one in the industrial development of Paraguay, and if, as is not unlikely, it should prove to be the beginning of a great new and ultimately enduring enterprise, Captain Martino and the other gentlemen who were present, no doubt will be proud to have evidence of their interest in, and support of, the initial gesture.

The original agreement between the Paraguayan Government and Union Oil Company of California, signed in May, 1944, granted to the latter exploratory privileges over the entire Chaco for a period of ten years. During that time, Union undertook to supply the geological and geophysical crews and equipment required for such surveys as might be made; to find and develop such oil fields as might be present in the Chaco; and, in general, to supply all the equipment and operational "know how" necessary to the completion of a thorough job of exploration and exploitation.

As the Chaco proper occupies some 56,000,000 acres, the tremendous scope of such a project can well be imagined. The agreement provided for the establishment of investigation blocks, each 10,000 hectares in extent, on which drilling will be carried on until oil is discovered or the block is released. In the event of discovery, provision is made for the institution of smaller exploitation blocks (2000 hectares) in the immediate area of the discovery well. These can be held for a period of 35 years with the privilege of a 15-year extension, but in any event not more than 60 years total from the original date of the signing of the agreement. As virtual agents of the Paraguayan Government, Union will receive 85 per cent of the oil recovered, and will pay all expenses incident to the recovery.

Union Oil Company employed Western Geophysical Company to do the prospecting, and Drilling and Exploration Company to take care of the drilling. The latter was also delegated the task of building any roads necessary, erecting camps, warehouses, a hospital, and any other facilities that might be required to house and feed the operators, the geophysical and other field crews. This included the development of an adequate water suppy, and the transportation of all essential equipment from the United States to the job site.

Exploration was actually begun about January 1, 1945, with Western Geophysical Company making the surveys under the direction of Earl Noble. The Chaco is flat, heavily wooded, and hence has



What's the Object of Using a Mechanically Operated Instrument That Can Give a False Record...When

The E[EA-SY]C Inclinometer

Always Gives a True Record

6 ways of using the E-C

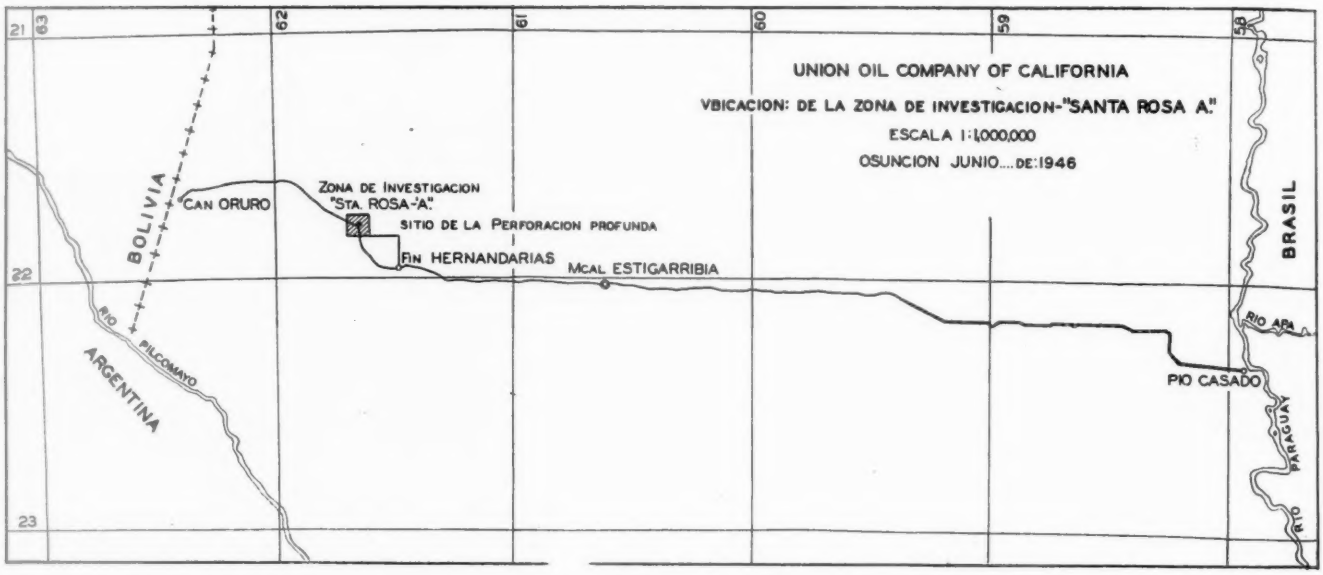
1. On Measuring Line.
2. On Sand Line.
3. As a Go-Devil and recovered when changing bit.
4. As a Go-Devil and picked up with a core-barrel overshot.
5. Run in with a core-barrel overshot when picking up a core.
6. Run inside of bailer in cable tool drilling.

You don't waste time with the E-C Inclinometer. It records automatically as soon as the plumb bob comes to rest. It's absolutely self-checking. How? Because electrical recording is not possible unless the E-C plumb bob is *standing still.* There is no uncertainty when you use the E-C. No re-checking. No waste of rig time. Faster to run. More economical.

SPERRY-SUN

SPERRY-SUN WELL SURVEYING COMPANY

Offices: Philadelphia, Pa.; Houston, Corpus Christi, Falfurrias, Marshall, Odessa, Texas; Lafayette, La.; Long Beach, Bakersfield, Calif.; Oklahoma City, Okla.; Casper, Wyo.



Map of the Union Oil Company operations in the Chaco, Paraguay.

little or nothing visible in the way of outcroppings or other surface indications to aid the geologist; and has few roads to facilitate the transportation of personnel and equipment. The difficulties involved in the organization of a sizeable venture of this sort in an almost uncharted area, far removed from sources of equipment and technically qualified and experienced personnel, are many. They appear to be resolving themselves, however, in that peculiarly satisfactory and satisfying manner that comes with well coordinated and concerted effort, well directed. It augurs well for the future success of this interesting project.

The first survey was made with one geophysical crew operating along the military road that runs across the Chaco in an east-west direction. As a result of this work, location was selected for the first well at Santa Rosa, alongside the military highway, and—a very important requisite — near a waterhole. Santa Rosa lies about 255 miles west of Puerto Casado, the point on the Paraguay River at which equipment is landed on its way in from Montevideo or Buenos Aires. At Puerto Casado, the freight is transferred from barges or river steamers to cars on the narrow gauge Carlos Casado railroad, whence it is carried west to Kilometer 160. In passing, Carlos Casado, the railroad owner, is reputed to be the second largest land owner in the world, his holdings being second only to those of the Belgian King in the African Congo.

At Kilometer 160, the freight is transferred to trucks and hauled, via Mariscal Estigarribia, to the well site by motor truck. From Mariscal Estigarribia on, the highway was constructed by Union Oil Company or its agents. There is no substantial settlement in the area, and the building and maintenance of roads is a major problem. It is further complicated by the flatness of the terrain, the density of vegetation, and the difficulty of disposing of water run-off — when there is any. Water is not easy to find, and when it is found and used for road building, the surrounding territory is so flat, that there is just no place for the run-off to go. During the rainy season, as a rule, there is too much water for the good of the roads. In any case, maintenance equipment is constantly in use, and that it has been doing the job satisfactorily is indicated by the fact that 900 tons of freight already have been hauled over the road to the well site.

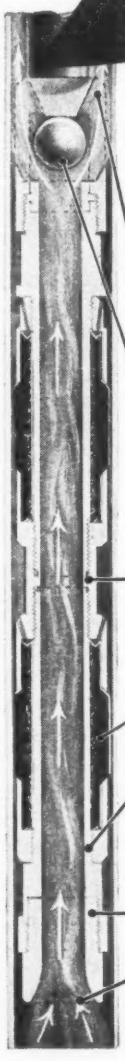
Drilling and Exploration Company sent Bob Evans, road and transportation superintendent, into the territory six months ahead of the equipment, to initiate the system of movement from the United States to the field, and according to all reports, Bob did an excellent job under extremely trying circumstances. Union's Paraguay headquarters, incidentally, are situated in Asuncion, from which much of the essential supply is shipped. Here the liaison office is maintained under the management of Chester Cassel. Union's petroleum engineer in Paraguay is Tal Ledbetter.

Returning again to the geophysical work, nothing unusual has been noted in the sub-surface conditions. Several months ago, Western Geophysical sent down a second crew, fully equipped, and now there is one group working in the western part of the Chaco, that is, in the general vicinity of the first well, and another porspecting in the southern section of the Chaco. The exploratory work was impeded somewhat by rain, which turned the ground into a morass, but when the rains cleared up fine progress was made. Often as many as 300 profiles a month are completed now. There are many obstacles to be overcome by a field party, working at such a distance from its sup-

Watching progress on the well are General Andino, a member of his staff, and American Ambassador to Paraguay, Mr. Willard Beaulac. In the background are Chester Cassel and a member of the geophysical party.

Meet the New Champ!

PATTERSON-BALLAGH ANNOUNCES A NEW



PATTERSON-BALLAGH'S new DEEP WELL SWAB is a true champion. It came up the hard way, licking one field problem after another through months and months of the toughest tests. *Now*, it is ready to take on all comers. When it comes to swabbing this new Deep Well Swab is a winner! *Developed by production men, it does the job production men want when swabbing.*

Large fluid passage clearances permit free dropping. Pulls either light or heavy loads from great depths without fluid loss, brings a complete load each trip. Sensitive, special rubbers expand under light load, proper cup support keeps them in place under heavy load. Easily adjusted to irregular I.D.'s of tubing and to compensate for wear. Simple design, made of standard parts in both tubing and casing sizes, easy to operate on rig floor, quickly tandemed. *A deep well Swab that really cuts swabbing costs.*

CHECK THESE FEATURES IN SECTIONAL VIEW:

- Large fluid passage.
- Standard reversible ball and seat, a pump manufacturers' part replaceable anywhere.
- Rubber quickly changed on job—break here to install rubber.
- Rubber easily adjusted—.042 inches under tubing I.D.
- Two reinforced PBX Special Rubbers used.
- API threads throughout. Lead Thread compound for easy break.
- All heat treated alloy steel. Tensile strength maximum. (Tensile strength 2½" Swab twice that of ⅜" sand line).
- All parts rust-proofed per rigid Navy specifications.
- Break here to tandem Swab.
- Large internal area plus streamlined inlet reduces tendency to blow out of hole to a minimum.

To expand rubber make up on cup. Use special gauges to check rubbers.

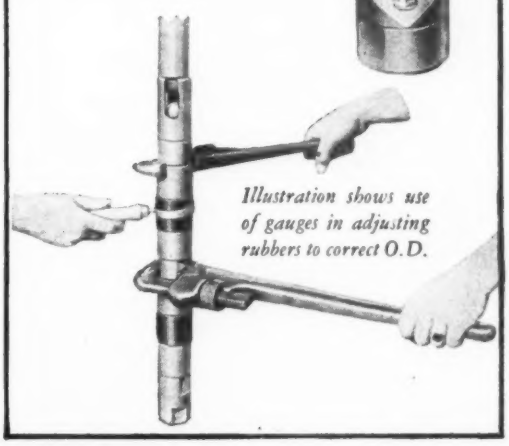


Illustration shows use of gauges in adjusting rubbers to correct O.D.

Specify

PATTERSON-BALLAGH

A DIVISION OF BYRON JACKSON CO.

"Best Bet Yet"

DEEP WELL SWABS

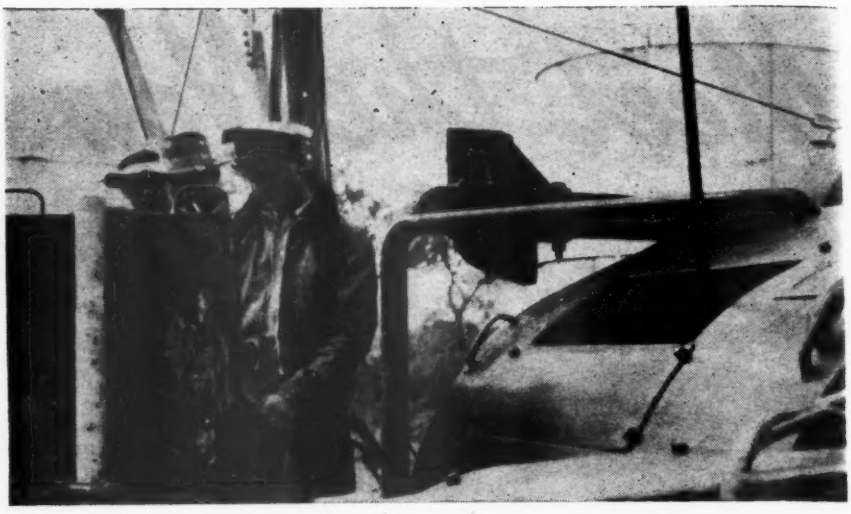
Main Office:

1900 E. 65th St. LOS ANGELES 1 · 6247 Navigation Blvd. HOUSTON 11 · 808 Graybar Bldg. NEW YORK 17 · 210 Post Street SAN FRANCISCO 8

ply base, particularly in an area where there are almost no roads, and where the territory is densely covered with vegetation. Pathways sometimes have to be hewn by machete crews. Tractors are used wherever possible, but even so, sudden heavy rains make road building a precarious business.

Water is really a precious commodity in many respects. In the rainy season there is too much in the wrong places, and in the dry season there is not enough in the right places. Some wells yield salt water and others yield fresh, and there is no way of telling in advance which it is going to be. Obviously, established water holes are not drawn upon any more than is absolutely necessary, for the operators have no desire to jeopardize the domestic supply of the local people. Most of the food has to be shipped in, but a little garden at Santa Rosa is already helping greatly to make up any deficiency of fresh greens, and other means have been instituted to provide fresh meats and other dietary essentials, as will be explained later.

Despite all the handicaps, progress is being made in all departments of this very pretentious project. In the geophysical work, data is accumulating fast, and reflections are fair, more or less the type that might be obtained in the Sacramento Valley of California, or the tertiary basins of Wyoming. Now that sufficient equipment and personnel are on the spot and available to perform without interruptions, other than those imposed by local conditions, it may be expected that the pace will be accelerated in the next few months.



Captain Martino, Paraguayan Minister of Public Works and Communications, spudding Santa Rosa No. 1, for which he was paid at the prevailing drilling rate, much to his surprise and amusement.

Tal Ledbetter at throttle of engine that hauls equipment from Puerto Casado on the Paraguay River, over the Carlos Casado Railway, to Kilometer 160.

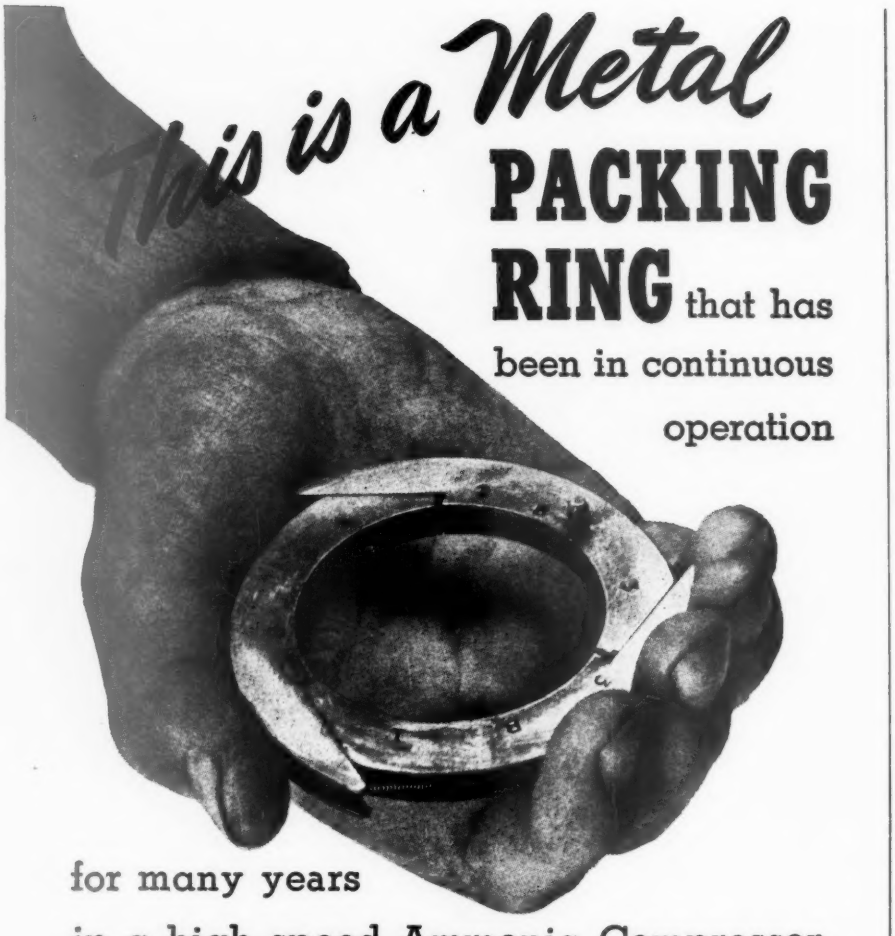
Because of its great weight, the transportation of drilling equipment was a formidable venture. It was heavier than anything heretofore handled at Puerto Casado, but nonetheless it was eventually dispatched to the interior and landed at its destination considerably in advance of its actual use. Much credit in this matter is due to Drilling and Exploration engineers who went in ahead of time to build roads, erect a complete camp for the drilling crew, including a refrigerating unit; to find an adequate water source, and to build a warehouse to store the 900 tons more or less of equipment and supplies that were needed to get operations under way.

It should perhaps be mentioned that a hospital was built to preserve the health of employes, and it is now doing yeoman service under the direction of a fine young Paraguayan doctor, who has already performed two successful appendectomies, besides taking care of a miscellany of other ills. It is also of special interest that the advance preparations included the laying out of a pasture, complete with 40 head of cattle, for feeding members of the geophysical parties, the well crews and other workers, and that a second camp was also constructed to house the workers.

Operations have been greatly expedited by the precautionary measures adopted prior to the shipment of materials. All manifolds were fabricated and sketched before leaving the United States, so that assembly on the job was simplified to the fullest extent. At the same time, all packages were identified completely by outside markings, thus making it comparatively easy not only to select the proper piece without opening, but to make sure that the various items could be uncovered in proper sequence, and only when necessary.

The drilling rig is a National 75, with 136-ft. derrick, and extra pumps. It is diesel powered and has done all that has

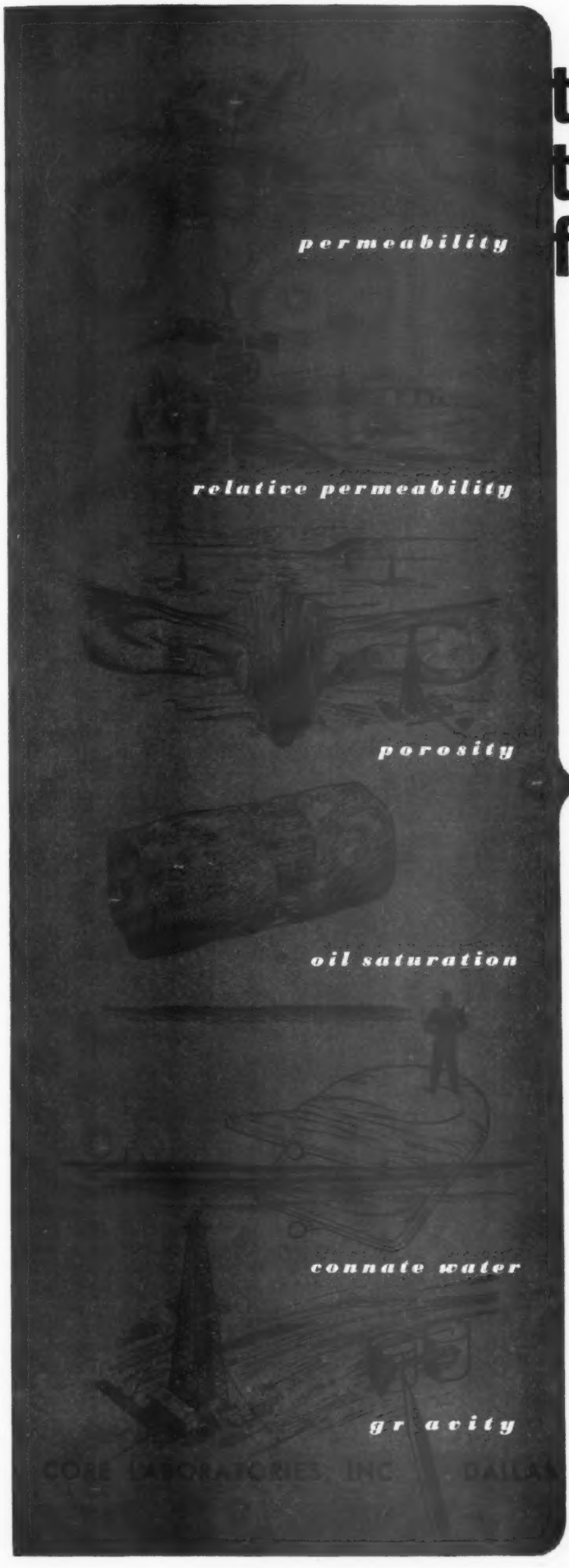
IN THE OIL FIELD . . .
The BIG Demand is for Tiger Brand!
BECAUSE: It has less tendency to whip and rotate. It runs fast and smooth, through the sheaves and onto the drum, enabling you to devote your full time to making hole.
Skillfully fabricated and precision preformed to close tolerances and unvarying quality standards, this stronger, tougher, more flexible rotary line offers maximum resistance to whipping, bending fatigue, load stress and abrasive wear.
Made by the world's largest manufacturer of wire rope, it is backed by a Field Engineering Service second to none! See your distributor—most stocks available for immediate delivery.
AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York
COLUMBIA STEEL COMPANY
San Francisco
Tennessee Coal, Iron & Railroad Company, Birmingham
Southern Distributors
United States Steel Export Company, New York
UNITED STATES STEEL
Excellay Preformed
USS
AMERICAN
TIGER BRAND
WIRE ROPE
UNITED STATES STEEL



been required of it to date. A fairly good mud is available within easy distance of the well, which solves what might easily have been a serious problem. H. D. Pike is drilling superintendent, with R. C. Reniers, operations superintendent, and up to the time of writing no trouble of any consequence had been experienced in the drilling process. This is the first well ever drilled in the Paraguayan Chaco, and naturally every move is being watched with the greatest interest. The actual drilling is being done by Americans, with Paraguayan helpers, who are being educated by the experienced operators, and are showing real enthusiasm, so much so, indeed, that the men from one tour will usually hang around to watch their successors perform, and can scarcely be persuaded to go to their homes. As already remarked, Santa Rosa No. 1 is now drilling ahead below 4000 ft. Regardless of the outcome of this first venture, other wells will be drilled, for the territory is obviously too vast to be evalued on basis of a single test bore.

There are two power plants, one for the rig, and the other for camp requirements. Among the other functions the camp plant operates the refrigerating plant, which has a freezing chamber 8 ft. by 8 ft. This enables the kitchen crew to hang beef and to preserve other perishable foods for the employes. Roads can only be worked, as already remarked, when water is available, and during dry spells they soon begin to need attention. The local system of patching holes with wet adobe—when water can be obtained—is amazingly effective, and the road workers become very expert in the process. In any case, this type of maintenance has been largely responsible for keeping the roads in good enough shape to accomplish the transportation of all the heavy equipment and supplies that have gone into the operating areas up to the present time. Union, by the way, has just purchased a plane for use in the Paraguayan operations. This will no doubt help in a substantial way to ease the transportation burden, and speed the acquisition of emergency materials and personnel.

There is every evidence of a dovetailing of interests and activities, which would indicate the highest degree of cooperation between the Paraguayan Government and Union Oil Company, and between the latter and the prospecting and drilling companies that they have retained to do the field work. To A. C. Rubel and Earl Noble, who are in direct charge of the operational phases of the project for Union Oil Company, should be given credit for its effective functioning. The carrying on of a task of this magnitude with smoothness and dispatch, the correlation of the multitudinous activities that are involved, and the improvisation of means to overcome every obstacle, require a species of direction that incorporates human understanding as well as executive talent. The success so far attending the total effort would indicate that these talents, too, are available. ★★★



theory to fact...

For eleven years Core Laboratories, Inc., has been serving the oil industry in the determination of reservoir characteristics for comprehensive evaluation of oil and/or gas bearing formations. Through this period of constant research, practical field and laboratory experience, development of trained personnel, and an increase in efficiency and quantity of facilities and equipment, major companies and independent operators have accepted factual interpretations of reservoir performance as developed by Core Lab from what were formerly considered to be theoretical research projects.

Core Lab's comprehensive service stems from On Location Core Analysis which, in reporting determinations of permeability, relative permeability, residual oil and total water saturation, calculations of connate water, measurements of gravity, and other supplemental information, supplies the basic data for correct interpretations vital to practical well completion and performance. Other phases of Core Lab's operations are Reservoir Fluid Sampling and Analysis; Field Testing; and Engineering.

Twenty-six portable and permanent laboratories are operating from base points at Dallas, Houston, Corpus Christi, Texas; Shreveport, Louisiana; Evansville, Indiana; Bakersfield, California; and Rangely, Colorado. Sub-base points include Midland and Tyler, Texas; Independence, Kansas; Natchez, Mississippi; Lafayette, Louisiana; and Oklahoma City, Oklahoma.

As the oil industry faces increasingly difficult problems of production with a greater necessity for efficient operations, Core Laboratories, Inc., continues to grow and maintain its position as first in the advancement of Petroleum Reservoir Engineering data and knowledge and its application to practical usage in controlled reservoir performance.

CORE

Crossing the Whangpoo at Shanghai

By **FRANK E. HANGS**

EXCLUSIVE

THERE are many interesting incidents in all projects or campaigns. One that aroused considerable local and human interest around Shanghai in October and November, 1945, was the building of a 4-in. military pipe line across the Whangpoo River.

The command decision following the Japanese surrender in August, 1945, was for American air force units in the interior of China to move Chinese armies to Shanghai, Canton, Pekin, and other points to receive the surrender of and to disarm the Japanese. Careful planning was necessary to obtain the quantities of 100-octane gasoline required and to have it available at points where needed to maintain the air-lifting operations.

It was clearly impractical to supply gasoline from India and West China as the "Hump" was bearing nearly all the traffic it could, and also it would require an average of three tons of fuel to air lift a ton from India to Shanghai. In other words, three gallons of gasoline were consumed to deliver one. Waterborne freight entering the port of Shanghai was the logical solution. Four Liberty ships with principal cargos of aviation gasoline in drums, which had been set up for supplying allied troops upon reaching the East Coast, were sent to Shanghai the latter part of September.

Initial shipments of gasoline were in drums. Later shipments were to be in bulk. Preliminary reconnnaissance of bulk oil storage facilities around Shanghai after September 8 disclosed that the Japanese had cut down most of the oil company tanks to salvage the steel for their war effort. Two tanks belonging to the California-Texas Company and six others belonging to Japanese interests nearby could be made usable, however, by cleaning and making minor repairs. These tanks were across the river and downstream from Shanghai. Kiangwan airfield, the principal airbase in the Shanghai area, was four and a half miles from the oil terminal, but across the river. The logic of a 4-in. military pipe line from the bulk storage was apparent. The Commanding General, Shanghai Base Command, directed the Base Engineer to proceed with the pipe line construction.

Outwardly this assignment, like many others, presented no serious problems; however, many difficulties were overcome before the mission was accomplished. The need for the gasoline was urgent. Personnel to build the line was not immediately available, nor was pipe. Another element that transcended all others was the peculiarities of the river itself: 3000 ft. wide at the crossing, 40 ft. deep on the channel side next to the oil terminals, and shallow on the Shanghai side, the Whangpoo is a tidal estuary. The tide rises 10 ft.; the flow and ebb causes strong currents. The river pilots have wholesome respect for these currents.

The first personnel assigned to the project was 18 Seabees, including a lieutenant and chief petty officer, from a detachment that arrived in Shanghai the latter part of September. Later, a lieutenant and 20 enlisted men from an army engineer petroleum distribution company (pipe line), who came to operate, assisted with the construction. A Coast Guard cutter and crew assisted in the later attempts and the successful crossing.

The pipe line on the land side presented no difficulties and was soon completed. The river presented a formidable barrier. Due to the urgency, it was planned to put over a temporary crossing of invasion pipe the latter part of September before heavier pipe came in port. The joints were burned off at the groove and the ends welded together, then 1000 ft. were pulled out on oil drum floats to be sunk and anchored later. An LCM* was used to handle the pipe. Unfortunately the tail end of an Okinawa typhoon hit the Shanghai area. The wind, waves, and current in the river made it impossible to maneuver the LCM and twisted the light pipe all out of shape. The crossing was a total loss.

Screw pipe now came to hand and a barge of pontoon cells was obtained. A tractor with a boom was put on the barge. It was planned to make up three or four joints and lower them while the barge was moved forward. This proved impracticable as it was not feasible to hold the barge steady enough to work on because of the currents. The pipe broke at the joints because of strains put on it.

At this juncture, about October 15, the gasoline supply at Kiangwan was becoming critical. Nearly all the drum stocks were exhausted. A drum-filling operation was begun at Cal-Tex. Filled drums were floated across the river and trucked to the field. The pipe line on the Shanghai side was extended down an old railroad bed two miles and around the Jukong docks. Here the navy supplied a small tanker (AOG) to shuttle gasoline from Cal-Tex to the Shanghai side and to act as floating storage This was completed and gasoline from the tanker to the airfield delivered early on the morning of October 22. This stopgap solution had several objectional features, such as:

(1) The Japs had allowed the Jukong dock to silt up and only an anchorage for one ship was available. This meant that while a victory ship was at the dock the AOG had to tie up alongside and throw her hose line over the deck of the victory ship, all the while the winch lines were working with stevedores milling about. Each time the victory ship moved out, the hose line was filled with water and broken. The AOG then had to stand off and come back alongside.

(2) Part of the dock adjacent to the anchorage was an old timber structure. Underneath were sampans and lighters filled with freight and supplies. As whole families lived in these boats, they had their charcoal braziers to cook their food. A real fire hazard existed in case a leak occurred in the hose or pipe on the dock and the gasoline dripped below. Incidentally, the unloading proceeded 24 hours a day and there were several million dollars worth of supplies and material in warehouses along the dock.

In any event, the pressure was off the crossing and that could be undertaken in a more deliberate manner. Another attempt was made along these lines. Several joints of pipe were welded together on the bank. The cutter "Sedge" planned to pull the pipe out with her tackle. The pipe was to be floated by being suspended by rope slings, tied to 4x4's across the gunwales of sampans anchored up and down stream to buoys previously planted by the Sedge (a buoy tender). After the ship channel was reached the pipe would be lowered as a unit by each sampan slacking off rope according to whistle signals. This operation was to be repeated on the opposite side of the river and the channel gap closed by a 300-ft. section with flexible joints. This plan failed because water currents playing upon the submerged pipe built up vibrations of such intensity that the pipe had to be cast off or pulled back ashore. It was pulled back by a tractor on the bank.

In all, four unsuccessful attempts were made. The successful attempt, as is often the case, was a smooth operation after all these disheartening experiences. Two strings of pipe each approximately half the width of the river were welded up side by side on the Cal-Tex tank.

*Landing craft mechanized.

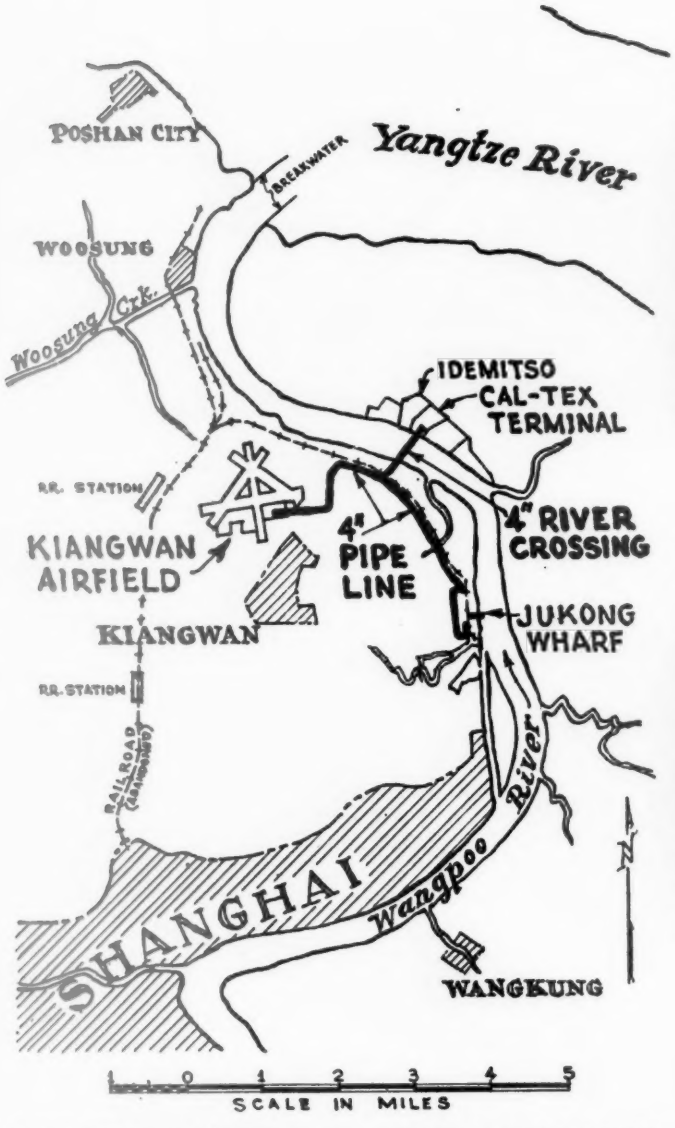
"PUTTING *Permanence* IN PIPE"

Pipe Cleaning, Coating and wrapping to any coating and wrapping specification

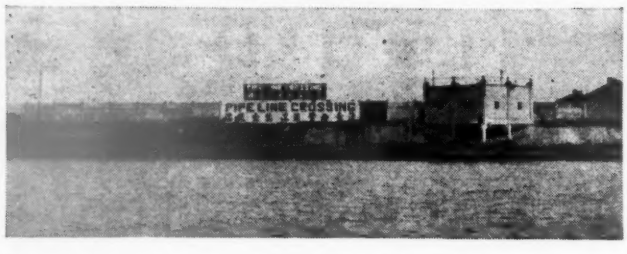
Complete Reconditioning Service for Old Pipe

MAYES BROS., INC.

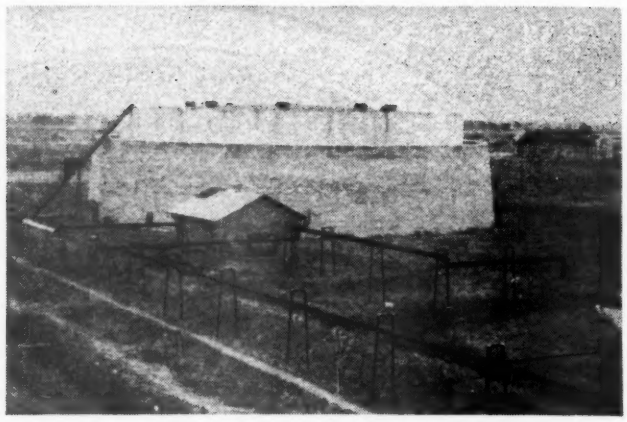
HOUSTON, TEXAS



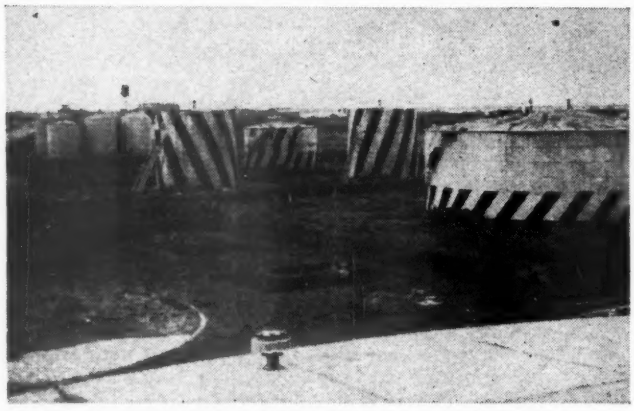
MILITARY PIPE LINE - SHANGHAI AREA



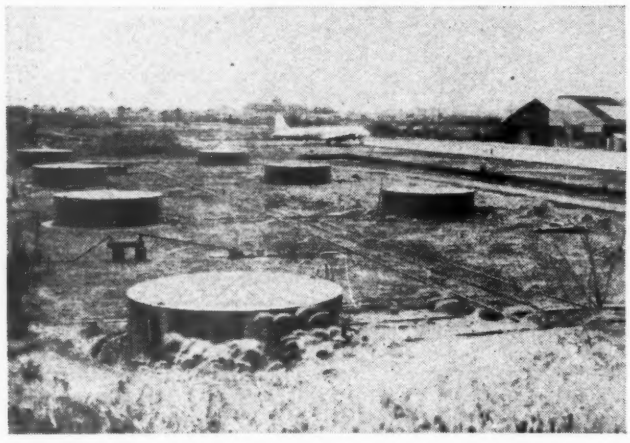
Pipe line crossing sign in both English and Chinese. At right is a Japanese block house.



Cal-Tex tank, 64,000 bbl. capacity, showing blast wall built by the Japanese.



Japanese terminal. Note spot in left foreground where tank has been cut down for steel.



Aluminum tanks of 1000 bbl. capacity at Kiangwan installed by U. S. Army.

On October 30, when the tide was just right—the slack water between the flow and the ebb—a 1-in. wire line was passed across the river and fastened to one string of pipe. The LCM was chained to the end of the pipe to keep it from gouging into the river bottom and to keep it on line. Two D-7 bulldozers in tandem on the Shanghai side provided motive power. The first string was pulled up to the end of the second string and the final weld made, then pulling was resumed. The crossing was down by noon October 30. Water pressure was left in the pipe over night and indicated a tight crossing. The pipe was then tied into the line on the Shanghai side and to the pumps at terminal across the river.

The flow was begun November 2, after a ceremony attended by high ranking army, navy, and air force officers, Chinese army and municipal government representatives and oil company officials. A project that seemed relatively simple developed into quite an undertaking. It attracted quite a little local interest because it was the first pipe-line river crossing at Shanghai. It was full of human interest because it was accomplished by cooperation of so many different units and services, the Seabees, Navy, Army engineers, Coast Guard, and the oil companies. ★★★

Not an Ordinary Emulsion Treater . . .

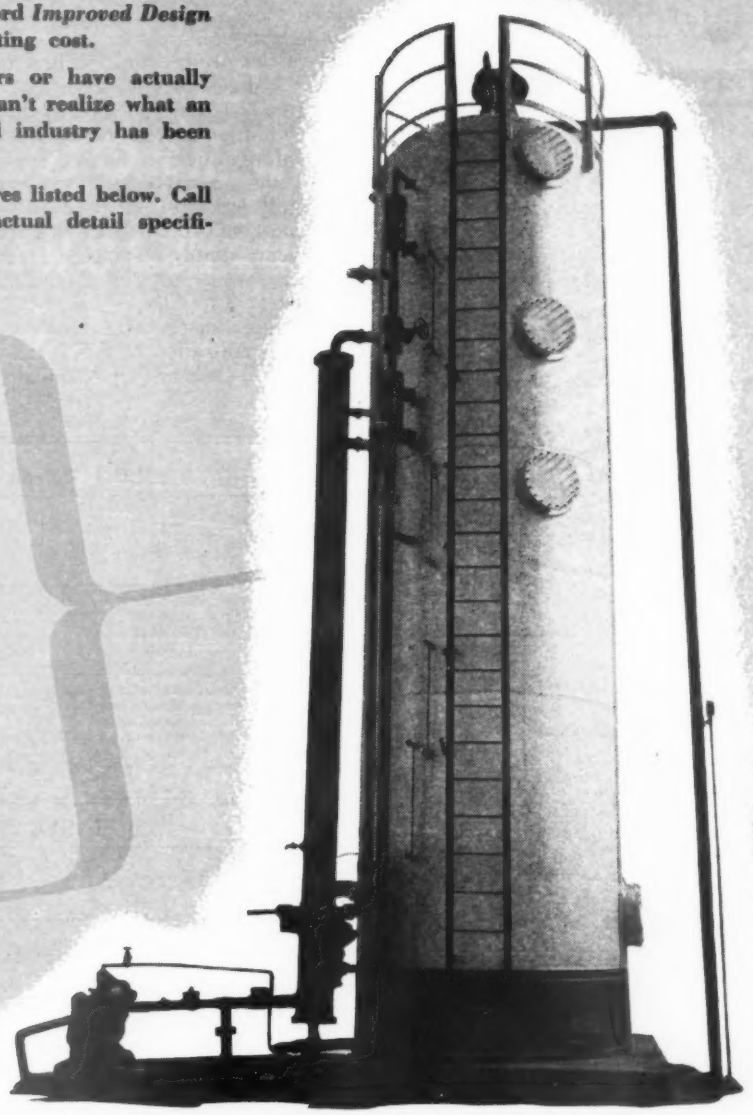
But a Distinct Improvement

OVER WHAT THE OIL INDUSTRY HAS BEEN USING

Greater treating capacity and lower shrinkage loss are shown by actual tests on the new Maloney-Crawford *Improved Design* emulsion treater—resulting in low operating cost.

Unless you have one of these treaters or have actually checked the operation of one, you just can't realize what an improvement they are over what the oil industry has been using.

It will pay you to investigate the features listed below. Call a Maloney-Crawford representative for actual detail specifications.



Maloney-Crawford Type M Emulsion Treater

STAR FEATURES

- ★ Long Travel Tray Section
- ★ High Capacity Free Water Knockout
- ★ Oversize Gas Separator
- ★ Adjustable Outside Water Siphon
- ★ Improved Outside Heat Exchanger
- ★ Gravity Conservation
- ★ High Capacity Removable Furnace
- ★ Eliminated necessity of Filter Section
- ★ Easier Inspection and Cleaning Provision.
- ★ Safety Approved Ladder and Guard Rails
- ★ Quieter Settling Section

STOCKS AND SERVICES

Available at following principal oil centers: Dallas, Fort Worth, Houston, Corpus Christi, Odessa and Pampa, Texas; Tulsa, Oklahoma; Artesia, New Mexico; Laurel, Mississippi; New Orleans and Lafayette, Louisiana; Bloomingdale, Jackson and Mount Pleasant, Michigan.

MALONEY CRAWFORD

MALONEY-CRAWFORD TANK & MFG. CO.

P.O. Box 659 (Successor to Maloney Tank Mfg. Company) Tulsa, Oklahoma

EXPORT: JOHN H. BAIRD, 420 Lexington Ave., New York 17, N. Y.

Estimates of Russian oil resources

By **ERNESTINE ADAMS,** *Associate Editor*

ONE of the results of Russia's secrecy about her oil resources is the variety of estimates made by outsiders about the progress of this industry. American experts have given the Soviet credit for much heavier production during the war than she actually had, estimates generally quoted being away over the mark. On the other hand, figures on Soviet proved reserves accepted by economists in the United States are probably too conservative.

EXCLUSIVE

A reexamination of Russian petroleum resources is needed in view of the importance of the oil industry in the present shifting and resettling of world relationships. It is interesting to compare the only two leading nations that have great petroleum resources within their borders, the United States and Russia.

Figures for the two can be summed up:

U.S. and U.S.S.R. oil resources.

	United States*	Russia
Percentage of world production, 1945..	61% (1.711 billion bbl.)	5% (0.149 billion bbl.)
Percentage of world proved reserves....	32% (21 billion bbl.)	11% (7 billion bbl.)
Percentage of world reserves not proved	10% (50 billion bbl.)	30% (150 billion bbl.)

*These do not include oil resources outside of the United States held by American nationals or recent Russian acquisitions in Eastern Europe and Iran.

The reserves are, of course, purely estimates more or less agreed upon by American petroleum scientists. The proved reserves are based on present recovery methods, a procedure that does not stand still. For instance, the estimate of United States reserves of 21 billion barrels of oil with modern recovery methods would be only 9 billion barrels by the recovery methods used after the First World War.*

Estimates of reserves not proved are no more than expert guesses. The data above are among those often used as a basis for theories on reserves. Ultimate production must depend among other things upon petroleum demand in a future atomic age.

The figures for the United States are as accurate as our experts can compute at this time. The figures for Russia, however, show revision indicated by recently collected data.

● **Soviet production.** Published American estimates of Russian oil production for 1945 range from 225 million barrels to 300 million barrels. Russia has not released production figures since 1939 when the annual output was given as 217 million barrels. Those who had any opinion about the production during the war years simply assumed a gradual increase despite news of damage to the largest fields.

These estimates were far from accurate. An indication of this fact was evident in the address of Marshall Stalin on the Five-Year Plan given in February of this year. At that time he set two goals for annual Soviet oil production. By 1950 the aim of the Soviet is to attain a production of 258 million barrels, according to the program, and by 1960 an annual production of 436 million barrels is the goal.

Because oil production goals of the previous Five-Year Plans had been above production levels 242, 109, and 88 per cent, respectively (see Table 1), it is reasonable to assume that 258 million barrels represented considerable rise above the 1945 actual production. In August, Andrew D. Perejda, a government geographer and cartographer, pieced together from U.S.S.R. publica-

TABLE 1. Petroleum objectives in Soviet programs.

Years, inclusive	Previous annual production, million bbl.	Goal set, million bbl.	Increase proposed, per cent	Production attained, million bbl.	Increase attained, per cent
First five-year plan, 1928-1932	85*	291†	242	163	92
Second five year plan, 1933-1937	163	341	109	207‡	27
Third five-year plan, 1938-1942	207	390	88	226§	9.2•
Fourth five-year plan, 1946-1950	149	258	73	....	....

*Figures in first and second five-year plans include gas at the rate of 1000 cu. meters of gas for 1 ton of oil. Tons are reduced to 7.27 barrels per ton for convenience. Amount of gas is small. Of the 85 million barrels, representing 11.7 million tons, 11.4 tons were oil, 0.3 tons were gas.
†Final upward revision as stated by G. T. Grinko, vice-chairman, State Planning Commission of U.S.S.R.
‡This and later figures for oil only.
§1940 production, closest available.
•In 3 years.

TABLE 2*. Russian oil production.

Region	1940 production, bbl.	Per cent of total U.S.S.R. production	1945 production, bbl.	Per cent of tota U.S.S.R. production
Baku	158,398,800§	69.89	90,825,000	61.09
Maikop	37,056,600	16.35	726,600	00.48
Grozny			9,445,800	06.35
Daghestan	.....	.....	2,543,100	01.71
Total Caucasus	195,455,400	86.23	103,540,500	69.65
Ishimbaevo	10,971,660	04.84	7,266,000	04.88
Tuimazy			3,524,010	02.37
Buguruslan	72,660	00.03	9,082,500	06.10
Kuibishev	2,179,800	00.96	1,089,900	00.73
Krasnokamsk	726,600	00.32		
Total "Second Baku"	13,950,720	06.15	20,962,410	14.08
Emba Basin	5,013,540	02.21	7,266,000	04.88
Turkmenia	4,199,750	01.85	4,722,900	03.17
Kalininneft†	715,700	00.31	2,143,470	01.44
Voroshilovneft‡	1,089,900	00.48	581,280	00.39
Ukraine	2,906,400	01.28	2,906,400	01.95
Crimea				
Sakhalin	3,116,740	01.47	6,138,000	04.39
Total non-Caucasus	30,992,750	13.76	44,720,460	30.30
Total U. S. S. R.	226,464,810		148,979,960•	

*"Russia's Oil," Andrew D. Perejda, *The American Review on the Soviet Union*, publication of American Russian Institute New York.
§Conversion factor is 7.266 bbl. to 1 metric ton from U. S. Bureau of Mines.
†Bukhara-Fergana area.
‡Upper Amu Darya River area around Termez.
•The 1945 total includes production of Pechora Basin at 719,000 bbl.

*"Technology — The Great Multiplier", by John M. Lovejoy, in *Our Oil Resources*, a symposium published by McGraw-Hill Book Company, New York.

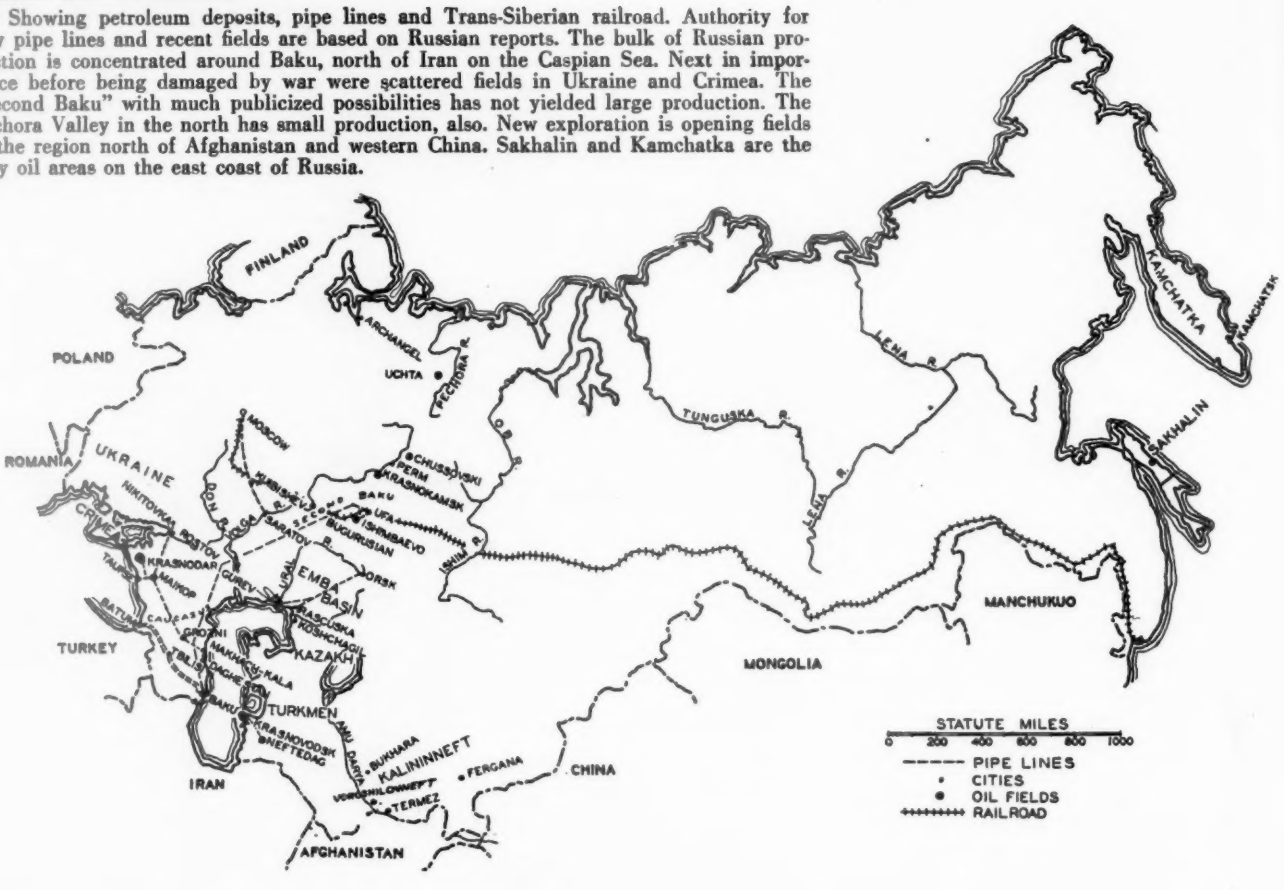
J. R. HORRIGAN CONSTRUCTION CO.

Pipe Line Contractors

Commerce Bldg. Houston 2, Texas

MAP OF RUSSIA

Showing petroleum deposits, pipe lines and Trans-Siberian railroad. Authority for new pipe lines and recent fields are based on Russian reports. The bulk of Russian production is concentrated around Baku, north of Iran on the Caspian Sea. Next in importance before being damaged by war were scattered fields in Ukraine and Crimea. The "Second Baku" with much publicized possibilities has not yielded large production. The Pechora Valley in the north has small production, also. New exploration is opening fields in the region north of Afghanistan and western China. Sakhalin and Kamchatka are the only oil areas on the east coast of Russia.



tions a detailed production record for 1945 (see Table 2). This showed a total of 149 million barrels* of oil produced for the year, which is probably as reliable as any available data. The 258-million-barrel goal for 1950 would represent a 73 per cent increase, lower than those of former plans but logically lower on account of reconstruction problems following the war.

Another indication of low oil production in the U.S.S.R. is the determination with which oil fields in Eastern Europe are held by Red occupation forces. From one-half on up of the oil production is shipped into Russia as reparations. There has been specific objection to Soviet control of oil fields because of reports that over-production in all these areas is doing great damage to fields belonging to private companies. Some of these are foreign concerns, usually American, British, Dutch, and French.

A recent Associated Press release, for instance, stated that officials of the Hungarian-American Oil Company have estimated damage to Hungarian oil and gas resources at about $15,000,000, caused principally by Russian control of fields in southwestern Hungary, where production is forced beyond economic rates. Similar reports have come from Rumania, Poland, and Austria.

Whether this over-production is the result of deliberate effort to obtain much needed petroleum or simply the Russian method of oil production is debatable. Engineers with some knowledge of the Baku fields have reported in the past that output was maintained chiefly by drilling more wells for flush production. This type of wasteful operation was said to result from the fact that the men in charge were judged by the Kremlin more on the basis of immediate volume than on economic methods of production.

So long as information from Russia is limited to "reports" and "rumors," however, any comment about her industrial methods must be speculation.

● **Reasons for production drop.** There are several reasons for the sharp decline in Soviet petroleum output.

Russia's most important oil-producing region, Baku, was not taken by the Germans but the war adversely affected production. Danger from the enemy caused much of the equipment and personnel to be moved farther into the interior, leaving the rich Caucasus stalemated so far as oil development was concerned and production fell off. The Baku fields contributed 70 per cent of the total Russian supply in 1940. The output dropped to little more than half the 1940 figure during the war.

Two areas, Maikop and Grozny, which supplied 16 per cent of the total 1940 production of the U.S.S.R., were almost knocked out of the 1945 picture. Maikop was actually in German hands at one time and attempts were made to destroy the fields by both sides in the war. Grozny was subjected to heavy bombing and was greatly damaged.

To lose a large share of the production from the Caucasus, which made up 86 per cent of the oil-producing fields of the country, was a severe blow to Soviet production.

Outside of this war-affected area petroleum output rose from 31 million barrels in 1940 to 45 million barrels in 1945. These scattered fields provide only a small amount compared with the great Caucasus fields, however, so they did not balance the drop in the production in Maikop, Grozny, and Baku areas.

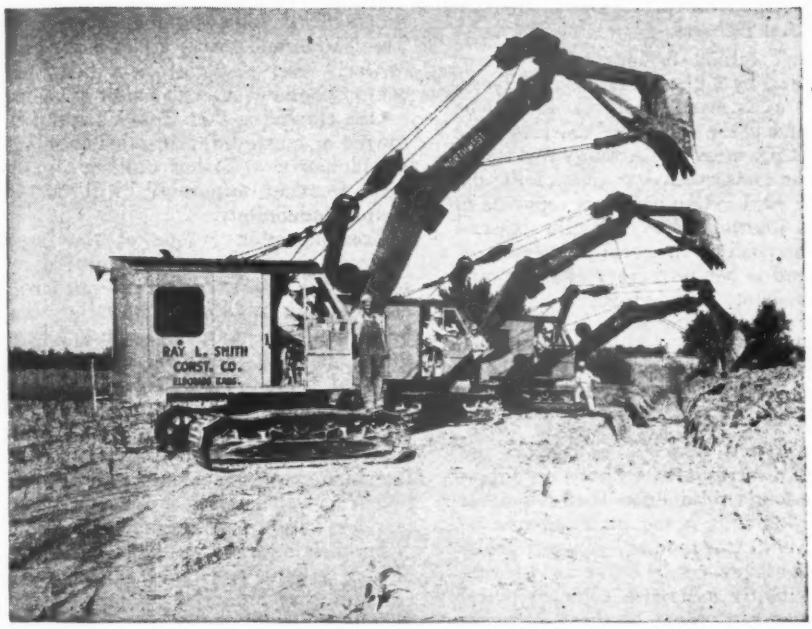
The second largest producing region in the U.S.S.R. is the area between the Ural and Volga rivers, a great geological basin with fields as far north as Chussovski. Known as the "second Baku," this district produced 14 million barrels in 1940 and increased the amount to 21 million barrels in 1945.

The Emba Basin, north of the Caspian Sea between the Emba and Ural rivers, is third in importance in producing oil. There was an increase here from 5 million barrels in 1940 to 7 million barrels in 1945. The greatest gain was made in the Kalininneft or Bukhara-Fergana area, which trebled its output during the war years to reach 2 million barrels.

One of the most significant areas is that of Sakhalin, both from the geographical and producing viewpoints. It lies on the eastern coast of the U.S.S.R., far from the other fields. Before the war

*This compares closely to the 1945 Oklahoma production of 139 million barrels. In 1945 Texas, leading oil-producing state, produced 749 million barrels.

★ ★ WE ARE EQUIPPED TO ★ ★
CONSTRUCT-RECLAIM-RECONDITION



PIPE LINES
OF
ANY SIZE
ANY LENGTH
ANY PLACE
ANY TIME

★

PIPE LINE

RAY L. SMITH CONSTRUCTION COMPANY
PIPE LINE CONTRACTORS
HAZLETT BUILDING — EL DORADO, KANSAS

Russia and Japan had an arrangement whereby the operating and the production were left mostly to the Japanese. Now the peninsula belongs to the Soviet exclusively. Production doubled from 1940 to 1945 but it is still low. The fields are said to be particularly rich and the region largely unexploited.

From available information it appears that the figure of 149 million barrels production for 1945 is reasonable to accept. It amounts to some 5 per cent of the total world production instead of the 10 or 11 per cent usually given. There is good basis for predicting that the Soviet will more nearly achieve the 1950 goal than she has previous ones. It is said that 34 new fields were discovered during the war and will be developed. An extensive drilling program is reported to be in process and certainly the Caucasus fields should regain a substantial amount of their former output.

There are a few drawbacks. One is the evident lack of good oil field machinery and equipment. There have been many reports about negotiations by the Soviet for American oil field machinery but so many complications have arisen that transactions seem to be in abeyance. The Russo-Swedish trade agreement promises some supplies in this line.

Another obstacle may be difficulty in getting the Baku field back into shape where reports are not so encouraging to increased production. Lately water encroachment of some proportions has been reported.

● **Proved reserves.** In estimating Russian known reserves the American and Soviet figures at first glance appear as wide apart as the two poles, but like the poles they are found to be similar.

In the last estimate published by the Russians* known petroleum reserves were set at nearly 63 billion barrels. This figure seems ridiculous in comparison with the 6-billion-barrel proved reserves allowed Russia by American experts who estimate available world reserves at about 65 billion.

Breaking down the Soviet figures, however, they are not so far out of line with the American estimate.

Professor Ivan M. Gubkin, Russian geologist and oil expert, is considered an authority on his country's reserves. His report to the International Geological Congress in 1937 showed that he divided Russian reserves into five classifications, which are: (1) explored, (2) prepared, (3) visible, (4) supposed, and (5) possible reserves. The first three types make up "industrial" reserves, that is, reserves ready for use or "available," as we say. In 1937 Gubkin divided the Soviet reserves thus:

	In metric tons	In barrels (42 U. S. gal.)
Industrial reserves	883 million tons	6 billion bbl.
Supposed reserves	2994 million tons	22 billion bbl.
Possible reserves	2499 million tons	18 billion bbl.
Total	6376 million tons	46 billion bbl.

In 1938 Gubkin published an article† in which he estimated Soviet reserves as:

	In metric tons	In barrels (42 U. S. gal.)
Industrial reserves	987 million tons	7 billion bbl.
Supposed reserves	3665 million tons	27 billion bbl.
Possible reserves	4010 million tons	29 billion bbl.
Total	8662 million tons	63 billion bbl.

In a country where a man's standing may lean upon the high estimate he puts on Soviet resources, Gubkin is not only a brilliant authority but very likely an accurate one. It seems apparent that American estimates have been based largely upon the professor's figures on industrial reserves.

The 7 billion in industrial reserves estimated by Gubkin can be readily accepted as "proved" reserves. It may be that some of the "possible" reserves come under this category. Certainly this figure must be conservative in view of the extensive exploration activities reported in Soviet journals. The Kremlin realizes its poor position in world petroleum affairs and is bending every effort toward improvement. Marshal Stalin was himself a worker in the Baku fields and he must disapprove highly of the weak record Russia has made since 1902 when she was producing more oil than all the rest of the world together.

● **Unproved reserves.** Estimating unproved reserves sets a figure on future and unfound production that can never be proved if it is too high but can be disproved if it is too low; yet most geologists are very conservative in judging these slightly indicative signs of petroleum deposits. Most of these surmises are based on Wallace E. Pratt's theory of distribution of sedimentary rocks favorable to petroleum.

In this field of speculation all geologists, both American and Russian, agree that the Soviet has the greatest prospects for future oil of any nation, so far as petroleum deposits themselves are concerned. Not long ago the People's Commissar for the Oil Industry, Nikolai Baibakov, was quoted as saying "With respect to natural oil reserves the Soviet Union occupies first place in the world." Baibakov no doubt was taking the top Gubkin figures but, regardless of that, if all reserves, both discovered and undiscovered are added, Russia has at this time, the largest amount within the border of any one state. It is estimated that the Soviet contains two or three times as much sedimentary rock of the petroliferous type as does the United States. If the Middle East were considered as one unit, the whole might offer greater prospects than the Soviet but at present oil rights there belong to United States, Great Britain, French, Dutch and Russian interests.

● **World position.** Russia's place in world petroleum resources is weak.

In 1945 world production reached 2783 million barrels of crude oil. Of this the United States produced 1711 million barrels or about 62 per cent. Venezuela was second with about 12 per cent of the world output. Most of this production is owned by U. S. interests, some by Dutch and British. The Soviet and Iran's British-owned production were each about 5 per cent of the total. Adding the production of Rumania, Poland, Hunbary and Austria, whose oil is taken by Russia for reparations, to that of the U.S.S.R. brings the percentage up to 7 per cent of world oil production controlled by the Kremlin.

In known available petroleum reserves the United States has about 60 per cent, both domestic and foreign and Great Britain controls some 23 per cent. Russia probably has about 11 per cent, if we take the 7-billion-barrel reserve estimated by Gubkin as industrial reserves. The Netherlands owns about 5 per cent of world reserves, France less than 2 per cent, and other nations smaller amounts.

One trouble is that Russia's reserves, proved or unproved, fail to bring the oil production vital to her economic progress. Demand apparently will outrun supply indefinitely.

Transportation is one of the large obstacles in development of proved reserves. Pipe lines are few—although considerable building of new lines has been planned—and production is all too often far from industrial centers. The bulk of transportation of oil in the U.S.S.R. is now made by tank cars carried over rails that are few and overloaded. The new Five-Year Plan calls for much greater increase in oil production from fields closer to industrial centers, less output from areas farther away.

Another hindrance is that a good part of the prospective oil regions have climates that hinder development. The difficulties of all-year-round ice have been encountered by American prospectors in Canada and Alaska and they know that climate can be discouraging to an obstructive point. Many problems must be solved without recourse to known methods and sometimes work must be stopped entirely, so progress is necessarily slow. Add these conditions to the transportation job and Siberian output might be uneconomical even for Russia.

● **Conclusion.** Russian oil production is the lowest it has been since 1930, indicating heavy damage to important fields. Prospects of an immediate and sharp upturn are not encouraging but present effort should begin to show results by the end of the Five-Year Plan now in effect, and may reach the goal of 258 million barrels annual production by 1950.

Reserves will show growth but it is doubtful under present methods that Russia will ever realize as much from her great petroleum resources as the United States has done and continues to do.

With the most liberal estimates Russia's position in world petroleum resources is likely to remain in its present low place in the list of the great world powers for many years. With even fair industrial development the Soviet will not find it easy to fulfill her own peacetime demand for petroleum products. Those who predict a Russian war fail to explain how the Soviet could produce the necessary oil to power a modern conflict. ★★★

*"USRR", published 1939 by Scientific Publishing Institute of Pictorial Statistics in Union of Soviet Socialists Republics (in English).

†"How Much Oil Has Russia?" Solomon M. Schwarz, *Foreign Affairs*, July, 1946.

Tank Owners throughout the oil fields have proven for themselves, by actual experience in their own tanks, that "Natasco" Products will definitely solve **Corrosion** and **Leaky Tank** problems.

Regardless of size, or whether you plan on New or Re-Built tankage, "Natasco" Insulation at the time of erection will extend the life of the tank indefinitely.

If you plan to clean-out and repair old tankage, give serious thought to the advantages of "Natasco" Insulation and Seal. Many old tanks, even in severe **"Sour-Oil"** districts, are giving perfect service today because of the foresight of their owners in using "Natasco" Protection.

We will gladly furnish any tank owner with complete information about "Natasco" Products and their uses for . . .

Insulating Inside Surfaces to Prevent Corrosion
Sealing Old Tank Bottoms to Prevent Leakage
Sealing Tank Tops Vapor-Tight
Minimizing Fire Hazard

WRITE **WIRE** **TELEPHONE**

"NATASCO"
CONSERVES

TANK SEAL PRODUCTS COMPANY

Post Office Box 617-W **Tulsa 7, Oklahoma** **Telephone 2-4149**

P 130.

Socony-Vacuum European refinery operations

DURING March, 1946, the Socony-Vacuum Oil Company, Inc., refinery at Notre Dame de Gravenchon, in France, near Le Havre, was returned to service. This represents the only significant change in status during the last 12 months of any of the manufacturing plants that prewar had been operated by Socony-Vacuum through its European companies.

EXCLUSIVE

By the end of the war in Europe, of the major facilities installed at Gravenchon for producing a wide range of gasolines, quality lubricating oils, fuel oils, etc., there remained only the power plant (damaged), a cracking unit (damaged), and very little usable tankage; distribution systems for steam, electricity and water had been destroyed or damaged in major portion. Thus, and because of the lack of materials and equipment, it has not yet been possible to manufacture the former diversity of products. Present operations are necessarily extremely simple—the unit that was designed and used previously for cracking only has been converted into a combination crude distilling/cracking plant with a crude charging capacity of approximately 4000 bbl. per calendar day; of the crude changed approximately 60 per cent is recovered as gasoline, with fuel oil the only other product.

At Frontignan, not far from Marseilles, the charging stock is now reduced crude rather than the shale oil that was being processed at the end of 1945. Here, as at Gravenchon, the principal processing units were badly damaged, the cracking unit being among those requiring major repairs. Thus, with no cracking facilities available, resort has been had to an operation that produces a straight run gasoline of very poor anti-knock quality. Reduced crude is being charged to the plant at the rate of about 1100 bbl. per calendar day. With dewaxing centrifuges, acid treating centrifuges, a plate and frame press, refrigeration facilities, etc., assembled from various sources Frontignan is producing about 220 bbl. per calendar day of motor oils, 160 bbl. per calendar day of spindle oil, petrolatum, and fuel oil.

The refinery at Naples, Italy, was sequestered in 1941 by a decree of the Italian Government, with, subsequently, the control and ownership assumed by Azienda Gener. Italiana Petroli, a corporation owned by the government of Italy.

Socony-Vacuum's Italian company is now engaged in the formalities preliminary to their regaining physical and legal possession of the installation.

The plant suffered such heavy damage during the war that its operation as a refinery is impossible without quite extensive repairs; however, immediately after the Allied invasion of Italy the tankage and lines that could be made serviceable were repaired and used by the Allied forces for handling finished petroleum products in bulk.

Of the compounding plants situated in areas to which representatives of Socony-Vacuum have had free access, that in Birkenhead (England) and that in Wandsworth (England) are in operation; that in Rouen (France) has been partially repaired and is manufacturing products in limited quantities and grades; that in Vado (Italy) is not in operation and is still officially in the possession of Azienda Gener. Italiana Petroli.

Only the most meager data are available on the present status of the other European refineries, in which prewar Socony-Vacuum was interested through its European companies. Specifically, these were: In Germany, one at Bremen and one at Schulau; in what was formerly Poland, one at Dziediece; in Czechoslovakia, one at Kolin; in Austria, one at Kagran; in Hungary, one at Almas Fusito; in Romania, one at Brasov; in Jugoslavia, one at Brod.

Under the existing circumstances, it has been impractical to procure first-hand information on their condition and operations. As a general statement, all those that may be in operation are either under the direction of the Armed Forces occupying the area, or controlled, directly or indirectly, by the government of the country in which they are situated.

★★★

Jersey operations

The foreign refining situation so far as Standard Oil Company (New Jersey) is concerned is substantially the same as last year when it was reported by W. J. Haley in *The Petroleum Engineer* for October, 1945. There has been a resumption of operations to a limited degree in England and France, and some minor refining in Belgium and Denmark.

The Fawley, England, refinery operated by a Standard subsidiary is processing 12,500 bbl. a day for a government account. In France, the Port Jerome plant owned by the Standard Francaise des Petroles, a partnership of Standard, Gulf, and Atlantic companies, is running on a simple operation at the rate of some 13,000 bbl. a day. The Atlas refinery near Antwerp is processing about 1500 bbl. a day and at Kalundborg, Denmark, a small unit owned jointly by Standard and Shell interests processes asphalt primarily at the rate of about 350 bbl. a day.

P 165.

Company to explore Philippine holdings

E. D. WOODRUFF, president of Occidental Corporation, a wholly owned subsidiary of Transamerica Corporation, recently announced that the search for petroleum in the Philippines, interrupted along with many other things by war, would be continued with the aid of western capital and enterprise. Occidental now owns a substantial interest in the Far East Oil Development Company, Inc., a Philippine organization that holds the only two privately-owned oil and gas leases not cancelled by the Philippine Petroleum Act of 1937.

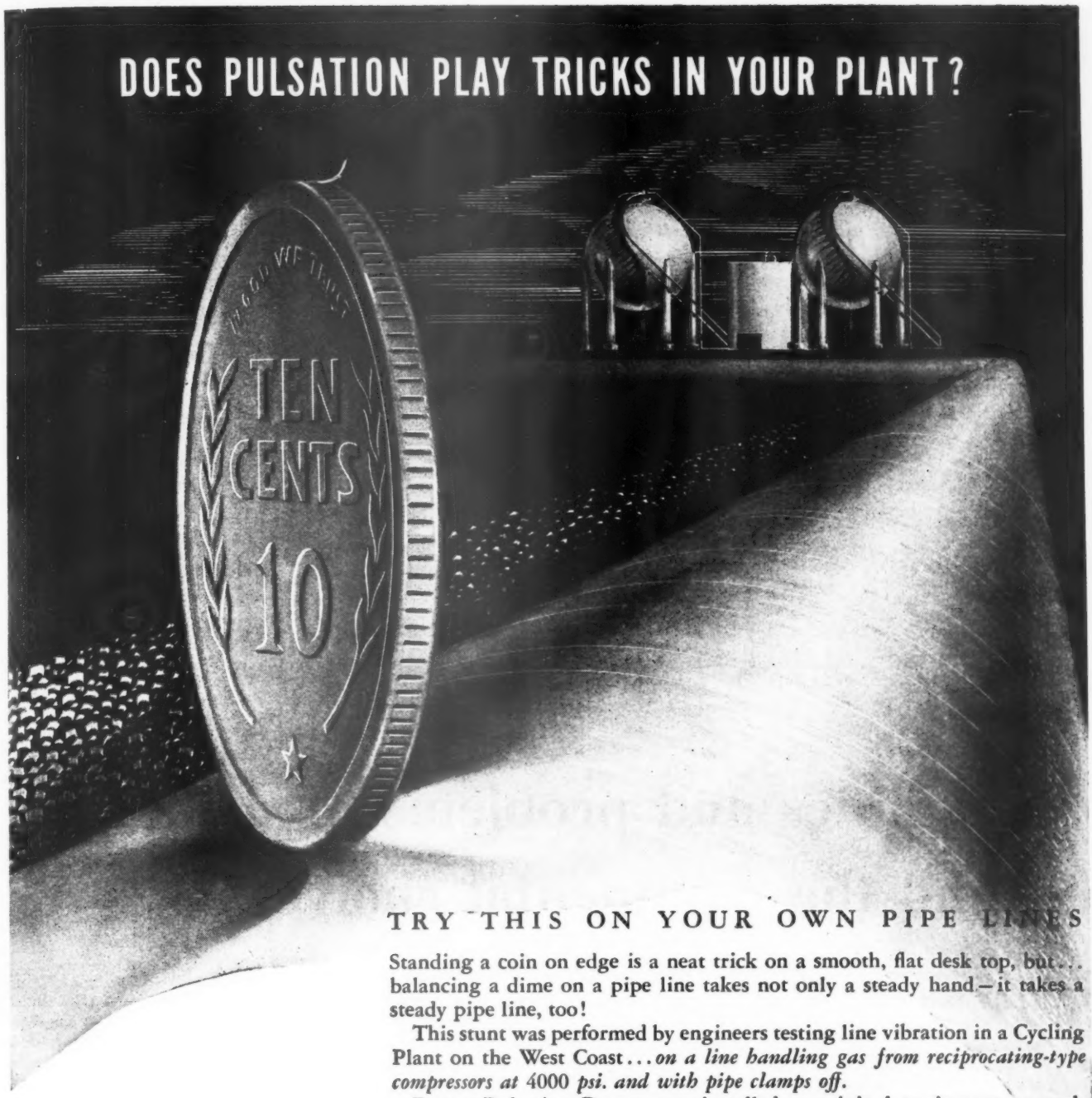
Colonel Andres Soriano, president of the Far East Oil Development Company, states that on November 30, 1941, a well then being drilled on one of the Company's leases was coring saturated oil sands. Before anything definite could be accomplished, however, orders were issued by General Douglas MacArthur to suspend operations and destroy all evidence of potential production.

The leases, covering 17,000 acres, situated in the northern section of the Island of Cebu, and on the Bondoc Peninsula, on the southwestern tip of the Island of Luzon, are said to exhibit well defined geological structures—demonstrated by the exploratory research carried on under the direction of Grant W. Corby, geologist. The ultimate program will, of course, be dependent on the results achieved in the first wells.

The Capital Company, of which Mr. Woodruff is also president, and which is also a wholly-owned Transamerica subsidiary, will provide the personnel, equipment, and operating "know how" to organize and initiate the field work, and to carry on the actual drilling and production on a fuller scale, should the first venture be successful. Other substantial stockholders in the Far East Oil Development Company, Inc., are Standard Oil Company of California, and The Texas Company.

★★★

DOES PULSATION PLAY TRICKS IN YOUR PLANT?



TRY THIS ON YOUR OWN PIPE LINES

Standing a coin on edge is a neat trick on a smooth, flat desk top, but... balancing a dime on a pipe line takes not only a steady hand—it takes a steady pipe line, too!

This stunt was performed by engineers testing line vibration in a Cycling Plant on the West Coast... *on a line handling gas from reciprocating-type compressors at* 4000 *psi. and with pipe clamps off.*

FLUOR Pulsation Dampeners, installed as original equipment on each high pressure discharge lateral in this plant, convert pulsative flow—inherent when reciprocating compressors are used—to a smooth, steady stream. By installing FLUOR Pulsation Dampeners *when the plant was built,* vibration caused by pulsative flow was stopped before it could get started. If you are planning to build a new plant or additions to your present facilities, it will pay you to investigate the FLUOR Pulsation Dampener now.

FLUOR Pulsation Dampeners eliminate the expense of accessory equipment to absorb vibration, such as clamps, anchors and expansion chambers; they save the extra cost of over-sized pipe and extra bends and effect substantial reductions in horsepower cost. This means a saving in original plant cost which more than pays for the FLUOR Pulsation Dampeners installed, plus lower operating and maintenance costs for the life of the plant.

WRITE FOR
FLUOR GENERAL CATALOG
NO. 46

BE SURE WITH FLUOR SINCE 1890

FLUOR PULSATION DAMPENER

THE FLUOR CORPORATION LTD., 2500 South Atlantic Boulevard, Los Angeles 22
NEW YORK • PITTSBURGH • KANSAS CITY • HOUSTON • TULSA • BOSTON

ENGINEERS • MANUFACTURERS • CONSTRUCTORS

P 422.91

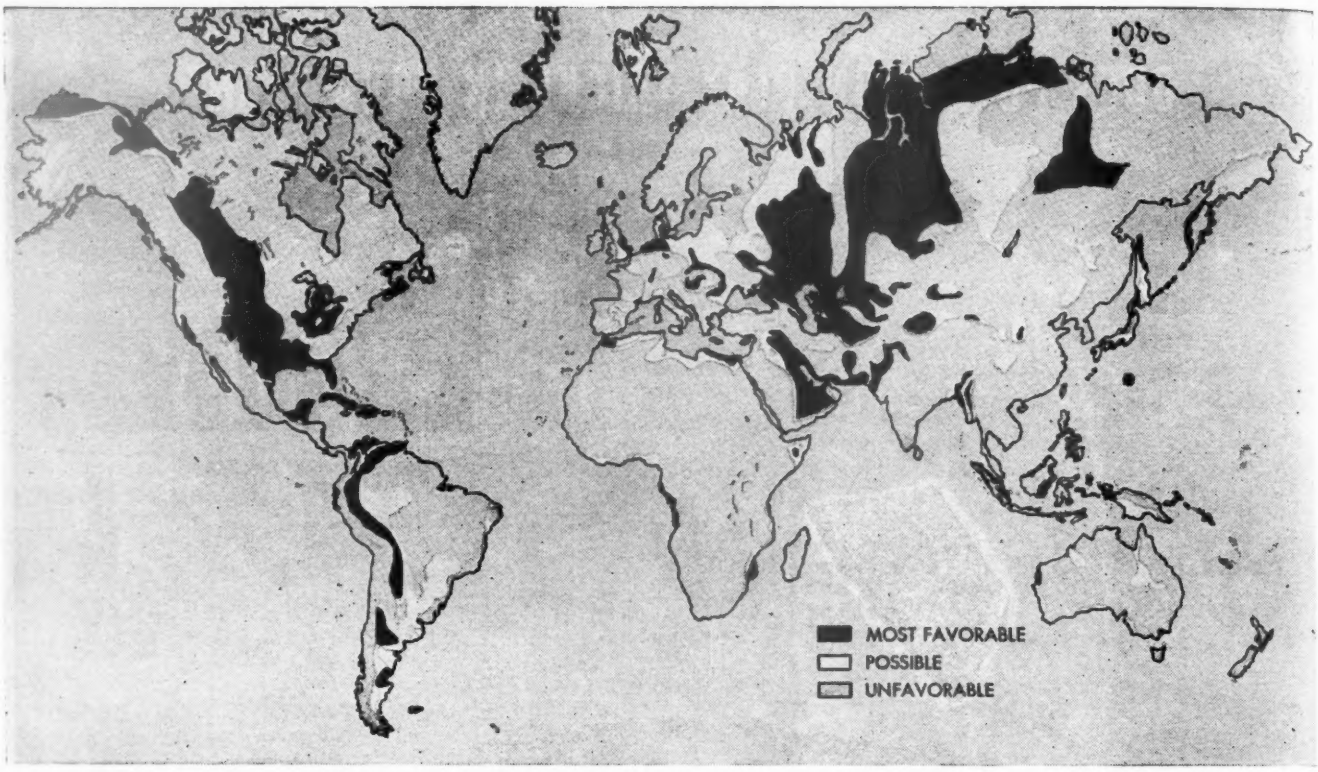


FIG. 2. Classification of the petroleum possibilities of the world. PAW map after Wallace E. Pratt data. FIG. 1, is shown in *The Petroleum Engineer*, July, 1945, Page 78.

Possibilities and problems of drilling beyond the continental shelves*

By **HENRY EMMETT GROSS**

● **Abstract.** The possibilities of the occurrences of petroleum beyond the continental shelves and the probable locations of deposits are discussed. A plausible method of drilling and its limitations are set forth.

● **Introduction.** Much attention is being given the problem of developing petroleum beneath the open sea. Geophysical surveys have been made 26 miles offshore[1] from the continental United States, and once offshore ownership is established, it is likely that there will be drilling for oil on the continental shelves.

More than two years ago the author presented the means for drilling in deep water at the Fall Meeting of the Petroleum Division of the AIME in Los Angeles. His concepts then were based on the use of rigid foundations suitable for drilling in water up to 600 ft. deep.[2]

● **General nature of the seas and oceans.** One hundred fathoms (600 ft.) quite well defines the outer limits of the continental shelves, and is thought to have been the maximum extent of land during glacial times. (See Fig. 1[3]. This map was reproduced in *The Petroleum Engineer*, July, 1945, page 78). Beyond this is the talus slope where has been gathered the continental debris, and it drops off quite steeply to the ocean floor, which for the most part is two to three miles deep.

It is the author's view that the land masses and oceans have undergone little change except for local variances that would not be great when considering the whole globe. On the other hand the continental shelves have been variable, sometimes extensive and reaching far into the continents as seas today represented by such as the Hudson Bay, Gulf of Siam, Gulf of Carpentaria, North and Baltic Seas, and the Bering Sea, or they may be very limited, as may be noted in the case of the present African continent.

The outer fringes of the continental shelves have been the collection places of the continental erosion products and it is there that very thick sections of sedimentary rock would be expected.

It is doubtful if any but a very small part of the deep ocean floor ever has seen light of day since the earth has had a hydrosphere. The abysmal ocean probably is underlain by a thin sedimentary veneer.

It is not the belief of the author that beneath the great oceans may lie vast lost continents. This does not mean that the smaller bodies of water (the Mediterraneans[4]) may not have had considerable portions now covered by a mile or more of water, either covered at one time by shallow water or actually exposed above the sea.

● **Deep water areas possibly containing oil.** Referring to Fig. 2 "Classification of the Petroleum Possibilities of the World,"[5] the great geosynclinal areas are set forth as most favorable places for petroleum. The dark area east of the North American Cordillera becomes more pronounced southward until it surrounds the Gulf of Mexico. Vast deposits of evaporites have been found in all our coastal states and the Isthmus of Tehuantepec by drilling around the fringes of this body of water, which would tend to indicate likelihood of such sedimentaries

*Presented at American Institute of Mining and Metallurgical Engineers Annual Meeting, Chicago, Illinois, February 26, 1946.

being found in the bottom of the Gulf. It well could be that the deep part of the Gulf represents a vast down warped graben containing thick and favorable sedimentation as well as evaporites.

Oil bearing sedimentaries might be found beneath the deep water areas within the great Malayan Archipelago extending from the mouths of the Irrawaddy southward thence eastward in arcuate fashion to New Guinea.

Other less extensive areas of landlocked deep water basins also may prove attractive, but are not so apparent from a study of Figs. 1 and 2.

● **Possibilities and problems of drilling beyond the continental shelves.** It being conceded that because restricted deep water portions of the hydrosphere might contain oil in commercial quantities, and that at any rate it is pertinent to know more of the nature of the lithosphere beneath the hydrosphere, that the possibilities and problems of drilling beyond the continental shelves be set forth.

Drilling in open water would offer few if any advantages over drilling on land. These are:

1. The ocean transportation is available to deep water drilling sites, and extensive pipe lines and roads are unnecessary.
2. Refinery facilities and markets perhaps are established on the nearby shore where adjacent fields on land are nearing depletion.
3. Freedom from jungle pests and tropical diseases.
4. Competitive drilling less likely.
5. Extensive areas attractive for development are not yet under lease or concession.

Disadvantages are great and numerous:

1. Storm hazards from wind and wave.
2. Expensive foundations, either rigid or floating.
3. Shutdown times because of weather not permitting operations.
4. Marine regulations of federal bureaus in addition to customary regulations on land.
5. Frequent difficulty in moving men and materials to and from drilling platforms.
6. Extra precautions required in open sea.

For drilling in water more than 500 or 600 ft. deep rigid foundations[2] become too costly and floating foundations must be used, and they must meet the following requirements:

1. The derrick floor and wellhead must be in the open air as on land.
2. The conductor pipe, casing and drill pipe when in use must be under constant tension and not undulating with the waves.
3. The derrick floor and drilling platform must maintain a constant level even when loading or unloading material, or landing casing or drill pipe on the bottom of the well, or when injecting into or removing quantities of liquids from the well and not rise and fall with the waves.
4. The foundation must be of the open type in that part of the structure subject to action of wind and wave.
5. The drilling platform must remain in a fixed position at all times and must have provided means for overcoming torsion imposed by the drilling operation.
6. The foundation must handle all the loads amply for the drilling of the well or wells if several wells are drilled from one location, and must provide ample storage space for rotary mud, and space for fresh water and crude oil to cover the needs of several days, at all times.
7. It is understood that under all circumstances metacenter conditions must be such that the floating foundation can not overturn.
8. Anchors must not drag.

This is the third paper of a series Mr. Gross presented to the AIME and had published by *The Petroleum Engineer*. The first one, "A Method of Drilling in Deep Water" was published in the Reference Annual, 1944, Page 68. The second appeared a year later in the July, 1945, edition under the title "Marine Petroleum Possibilities."

The Gross articles cover fundamental approaches to exploitation of shallow and deep marine oil deposits.

● **The foundation.** A foundation meeting these requirements is shown in Fig. 3. Item A is an open type substructure supported on hulls B, which are sealed on the decks and are submerged sufficiently to escape wave action in storms. Drilling platform C is sufficiently above sea level to be safely above any storm waves, 40 to 50 ft. Referring to the more detailed illustration of Fig. 4, hull B may be entered through manway Y. To keep the drilling platform at constant level, diaphragm Q causes water to be admitted to storage in the hull if it and the drilling platform tend to rise, and to discharge water if sinking, the pumping mechanism being in the hull. To maintain the drilling platform in a level plane a minimum of four points must have diaphragm controlled ballast stations, one being fore and aft in each hull to maintain an even keel* throughout and it probably would be better to have duplicate stations at each point for surety. Although items Q, R, S, T, and U are shown as being external, in practice they would be contained neatly within the hull together with the pumping mechanism, and the diaphragm element functioning for Q would be in a vertical cylinder or tube passing well above sea level and having small openings below sea level so as to tend to cut down the effect of undulations of the waves.

*The even keel submarine, long a highly successful war machine, was invented by the American, Simon Lake, a half century ago, and during World War II he advocated large cargo submarines.

Although theoretically the drilling platform would have no up and down movement, actually there probably would be a little. This would be undesirable for the casing strings O and P or drill pipe N. To keep these strings of pipe under constant tension hydraulic rotary tables I held under constant hydraulic pressure should be provided.

The conductor pipe would be worked as far into the sea floor as possible, assisted by underdigging with retractable type rotary bits.

To cut down anchor cable tension from wind blowing against the foundation and equipment exposed above the water, a cable diaphragm V similar to those used with weight indicators is secured to cable J and tube W carries fluid to the control mechanism, which operates reversible motors that drive propellers H in such manner as to relieve tension in the anchor cables.

Fig. 5 is a plan view of the floating drilling platform. When rotating the rotary table, any torque action thereon should be met instantaneously with an equal and opposite torque applied through propellers H′ provided for that purpose.

Manway Y, the means of entry to hull B, should be of as small a tube as conveniently would permit men to climb up or down the ladderway and a safety hatch should be provided beneath it. It would be best to have a manway fore and aft on each hull. Small diameter manways offer less resistance to storm waves, which when cusping hit with terrific impact.[6]

Pipe for carrying electric lines, oil, mud, or fresh water lines into the hull, should be spaced apart and enter the hull separately so as to offer less resistance to wave. The hulls should be large enough not only to provide ballast chambers of size sufficient to allow several hundred tons variation of load but ample storage tanks for oil, mud, or fresh water.

For ease of illustration hulls of the shape shown were depicted, but it is understood that other forms might be more advantageous. For example, a cigar shaped hull or even spheres, the latter offering the same resistance in all directions.

● **Anchorage by rigid members in tension.** A foundation using cables and diaphragm mechanisms has been set forth. Such an ocean drilling platform using a minimum of vertical members exposed to wave would require 1000 hp. for stabilization in big ocean storm waves. In the event an attractive oil or gas reservoir is found, for example in Santa Barbara Channel, California, the above means might be replaced with tension members of 8⅝-in. bouyant drill pipe. The drill pipe would replace anchorage cables and would be anchored either deeply beneath the sea floor or anchored on the sea floor by a suitably applied load.

Fig. 6 presents such an anchorage below the sea floor. The floating foundation would be fixed in place as discussed previously and as illustrated in Figs. 3

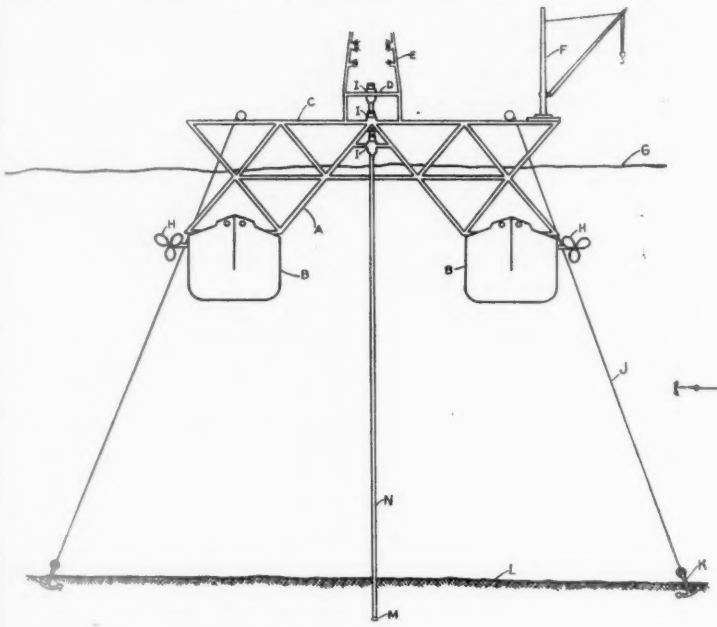


FIG. 3. Front view, marine foundation for use in water deeper than 600 ft.

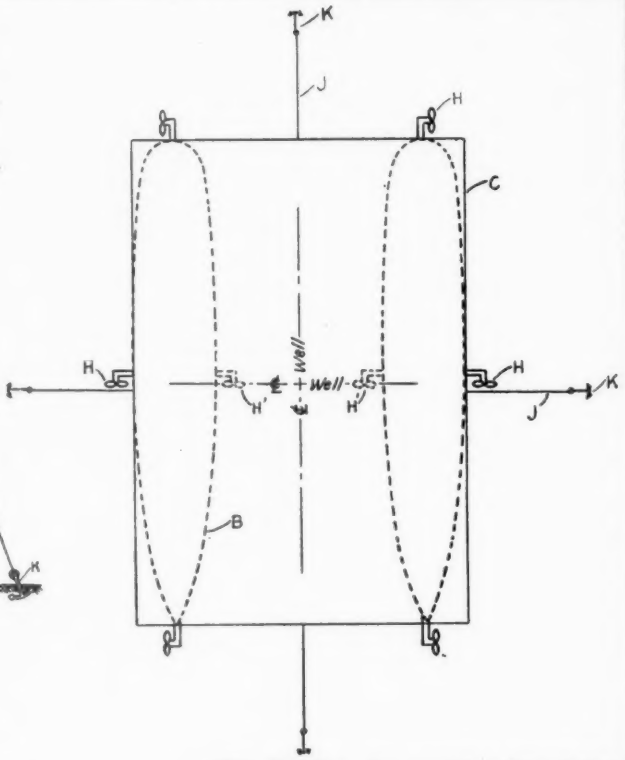


FIG. 5. Plan view, marine foundation for use in water deeper than 600 ft.

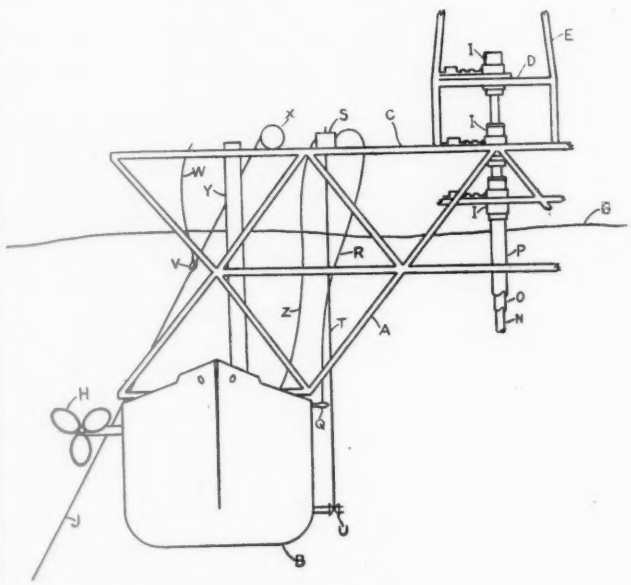


FIG. 4. Front view, enlarged portion marine foundation shown above.

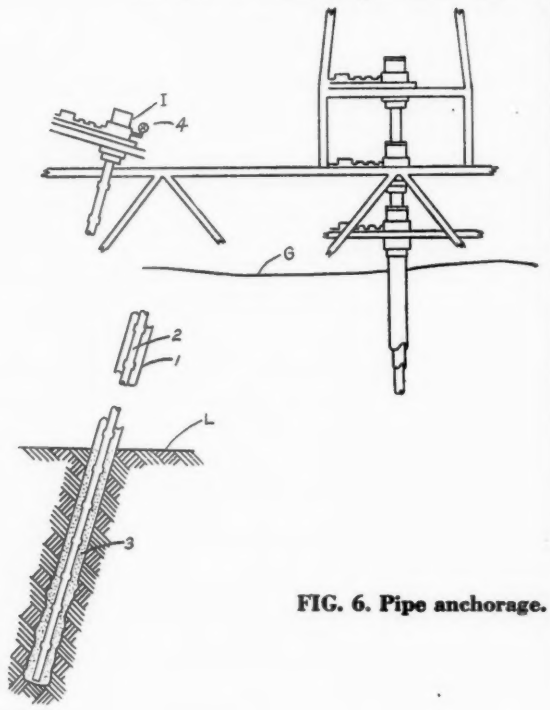
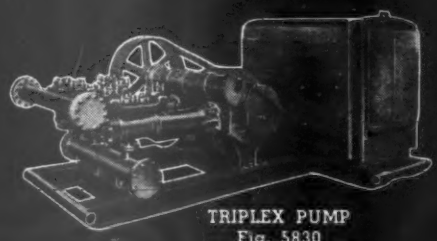


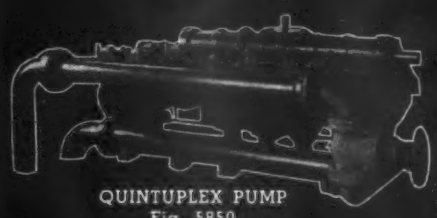
FIG. 6. Pipe anchorage.

A. Open type substructure
B. Hull
C. Drilling platform
D. Derrick floor
E. Derrick
F. Crane
G. Sea level
H. Propellers
H'. Propellers for torque
I. Hydraulic rotary tables
J. Anchor line
K. Anchor
L. Sea floor
M. Drilling bit
N. Drill pipe
O. Intermediate string
P. Conductor pipe
Q. Diaphragm to actuate valve
R. Tubing to carry diaphragm liquid
S. Mechanism by which diaphragm fluid actuates rod T to open and close valve U
V. Diaphragm to start and stop motors driving propellers H
W. Tubing to carry diaphragm liquid for controlling motors driving propellers.
X. Anchor hoist
1. Conductor pipe for anchorage
2. Buoyant anchorage pipe
3. Anchorage hole
4. Gage

DUPLEX PUMP
Fig. 2070
7" x 10" V-BELT



TRIPLEX PUMP
Fig. 5830
5¾" x 8" V-BELT



QUINTUPLEX PUMP
Fig. 5850
5¾" x 8"

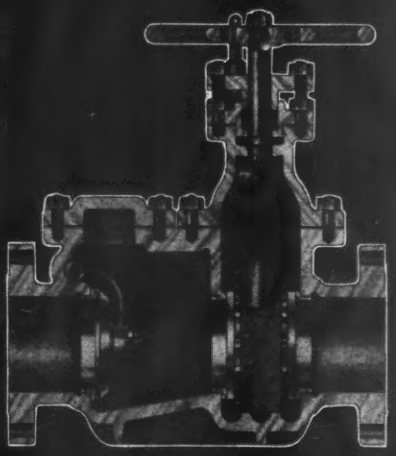
DIRECT DRIVEN PUMP
Fig. 1324
4" x 6"

When it Comes to PIPE LINES Come to WHEATLEY

V-BELT DRIVEN PUMP
Fig. 2170

TWIN STRAINERS
4" to 12"

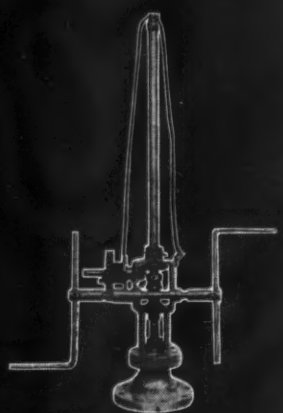
SYNTHETIC RUBBER SEAL
CHECK VALVES
2" to 18"



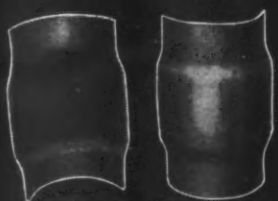
RACK TYPE TWIN VALVES
4" to 12"

RACK TYPE GATE VALVES
4" to 12"

PLUG VALVES
2" to 6"
Non-Lubricated
Mechanically Operated



TAPPING MACHINES



WELDING SLEEVES
2" to 12"

HALF SOLES
2" to 12"

FRANK WHEATLEY PUMP & VALVE MFR.

• PIPE LINE SUPPLIES •

TULSA 6, OKLAHOMA, U.S.A.

Successor to Wheatley Bros. Pump & Valve Mfrs.

and 4. Hydraulic rotary equipment designated I on Fig. 6 would be set at the proper place on the drilling platform, and a conductor pipe 1 would be landed at a suitable angle on the sea floor, and worked as far therein as possible with retractable bits. A releasing joint should be provided above but as near the sea floor as possible. With the conductor pipe in place, suitable hole could be made for anchorage. As the sea water at the bottom of the deep sea is cold, approaching O°C., the rock temperature at anchorage depth should be low, and after the anchorage hole is made a column of slow set cement could be spotted at the bottom thereof through the drill pipe. A string of 8⅝-in. buoyant pipe could be run and worked into the fluid cement and allowed to set. The conductor pipe could be parted at the releasing joint and recovered by the tedious process of stripping.

A plurality of such pipe anchorages could be placed in pattern around the platform. Pipe buoyancy may be provided either by having each joint an individually sealed chamber or by bailing the pipe until empty. The sealed chamber method could be used, having the pressure in each joint equal to the hydrostatic pressure at the depth the joint would be used.

Hydraulic rotary tables or chucks would hold the pipe at its upper end and a pressure gauge used with the chuck would show the tension at all times. A pressure element in conjunction with each hydraulic chuck could be used to relieve some of the pipe tension by use of power, as described in the earlier anchor cable discussion. The 8⅝-in bouyant pipes would have a maximum capacity of 800,000 lb. or a safe capacity of 400,000 lb. Pipe joints should screw together but be made so that they can not unscrew.

A modification of the floating drilling platform shown in Figs. 3 and 4, but having widespread flat bottomed hulls, might be lowered onto the sea floor by use of "even keel" principles discussed previously and the top of the hull be at least 30 or 40 ft. below sea level so as to be free from effects of storm waves. For the same reason the drilling platform should be about 40 ft. above sea level.

● **Miscellaneous.** The rapid improvement of heliocopters, meteorology, radio, radar, and landing craft will add greatly to the safety of crews working with open water drilling and producing equipment.

Anchor cables should be factory treated on manufacture by a highly effective monomolecular layer anti-corrosive, and the upper portion from a few hundred feet under water to the reel should be sheathed similar to electric logging cables. Diaphragms, and delicate working mechanisms should be made of non-corrosive materials.

There is no apparent means of protecting the floating type foundation from the tsunami or diastrophic tidal waves.

● **Conclusion.** It must be conceded there are probably oil deposits under water one mile or more deep and that these might contribute valuable petroleum supplies where production is waning.

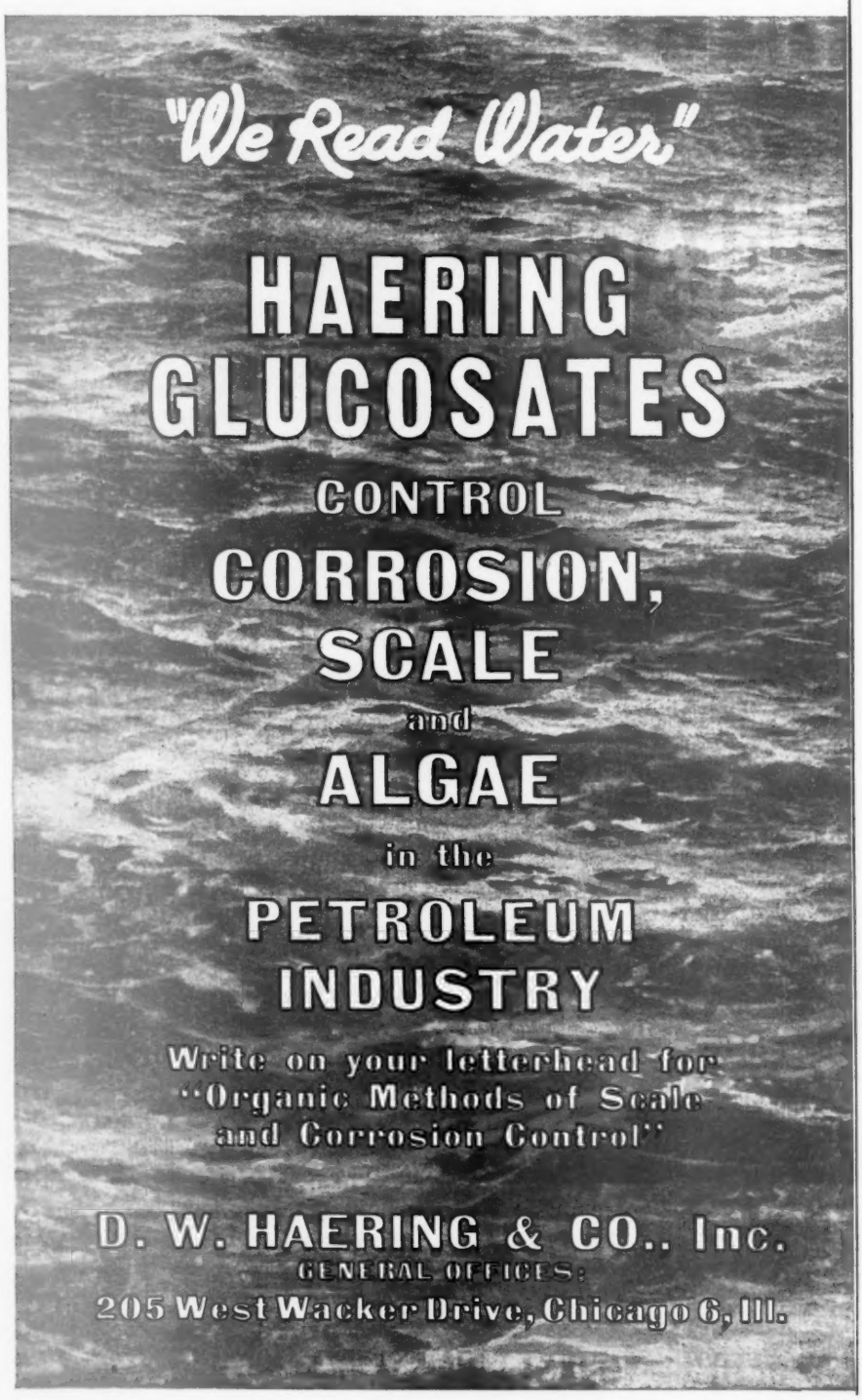
What appears to be a logical approach to drilling beyond the continental shelves has been discussed, but it must be emphasized that concerted and widespread thought may reveal better means.

Even though drilling in such deep water may not open commercially exploitable petroleum deposits, it is pertinent to the welfare of the nation that everything possible be learned of the nature of the lithosphere beneath the deep hydrosphere, so that if it is found to be one vast desert devoid of resources for man, then he must cease being prodigal with the resources at hand.

Bibliography

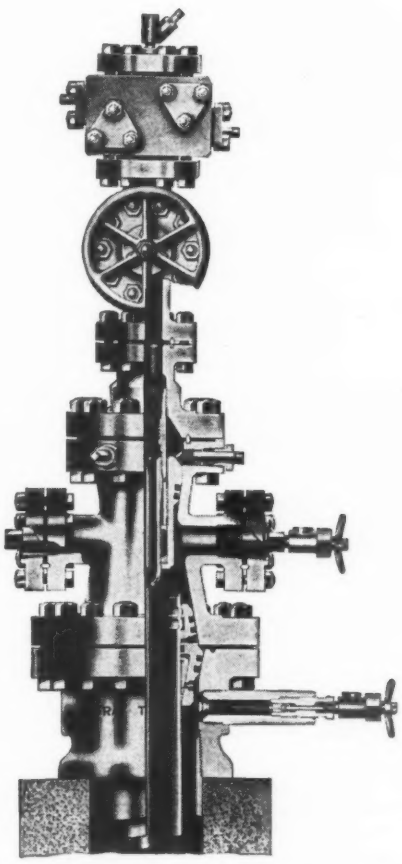
1. E. H. Short, Jr.: "Distant Offshore Seismic Survey Conducted in Gulf of Mexico," *Oil and Gas Journal* (August 26, 1944), Vol. 43 No. 16, p. 87.
2. Henry Emmett Gross: "A Method of Drilling in Deep Water," *A.I.M.E. Tech. Pub. 1722 (Petroleum Technology*, March, 1944). Also *The Petroleum Engineer* Reference Annual, 1944, Vol. 15, No. 10, p. 68.
3. Henry Emmett Gross: "Marine Petroleum Possibilities," *The Petroleum Engineer*, July, 1945, Vol. 16 No. 11, p. 76.
4. Wallace Pratt: *Oil in the Earth*. University of Kansas Press, Lawrence, Kansas, 1943.
5. Anonymous: "Classification of the Petroleum Possibilities of the World, after the Petroleum Administration for War," *Oil and Gas Journal*, December 29, 1945, Vol. 44 No. 34, p. 174.
6. Henry Emmett Gross: "Foundations for Aquatic Oil Wells." A thesis for engineer of mines degree, Missouri School of Mines and Metallurgy, Rolla, Missouri, 1934, P. 28 to 34.

★ ★ ★



ECONOMY is achieved through cooperating with fundamentals

Save by purchasing products which incorporate in their designs this fundamental:



Complete Well Head Assembly equipped with Composite Manifold, Valve Removal, Installation and Renewal.

SIMPLICITY—Fewer parts for us to manufacture, fewer parts for you to purchase, fewer parts to disintegrate and give trouble.

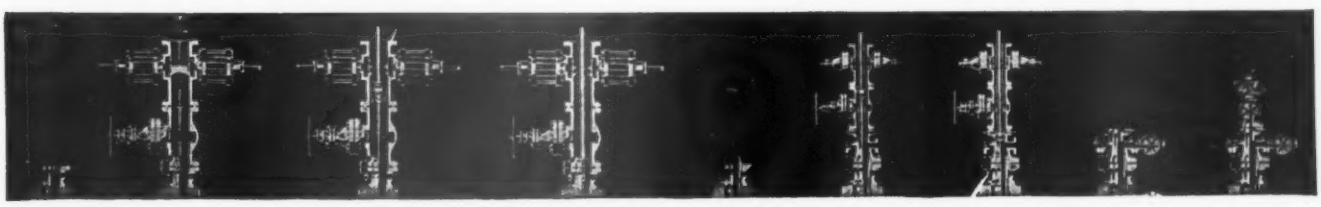
You'll get considerably more in both increased quality and lower operating costs for a smaller expenditure when you use GRAY Products.

During periods when the need for effecting economies is paramount, why not go to the company which has developed the "know how" through experience gained in exploring this most fruitful source for effecting economies?

GRAY
TOOL COMPANY
HOUSTON

Export Representative: GUY E. DANIELS, 30 Rockefeller Plaza, New York, N. Y.
Rocky Mountain Representative: CARL MOULDEN, P. O. Box 1890, Casper, Wyoming
Mexico Representative: W. Y. DE MOUCHE, Paris 12, Mexico City, D. F.

CONTROL DURING AND BETWEEN ALL OPERATIONS WITH GRAY PLANNED PROCEDURE



Casing Head Attached | Drilling | Running Casing | Casing Landed | Drilling Control Equipment Removed | Drilling-in and Running Tubing | Tubing Landed | Control Equipment Removed | Manifold Attached

P 934.35

Exchanging ideas and plans permits refinery training men to keep ahead of developments in their fast-changing field.

Trends in refinery training

By **HOMER T. FORT**
Industrial Relations Department
Magnolia Petroleum Company

How to make men as efficient as the machines they operate is the head-scratching problem that has always concerned the refining industry's personnel men. Now, more than ever, it has become the problem of all refinery supervisors, be they engineers or accountants, chemists or process foremen.

EXCLUSIVE

The effect of the wartime upsurge in industrial instruction, the postwar outlook, how solutions are being reached in the more pressing problems—these are some of the topics that currently bear on the training picture. Here, in the form of a mythical roundtable discussion, is an attempt to analyze these topics and point out their significance to supervisors who have come to realize that training is an answer to many problems.

Foreman: We heard a great deal about training during the war when the labor shortage was pressing us. Now that it's done with, does intensive refinery training go back in the woods or is it due to expand?

Training director: It's going to get bigger, and here are some reasons why:

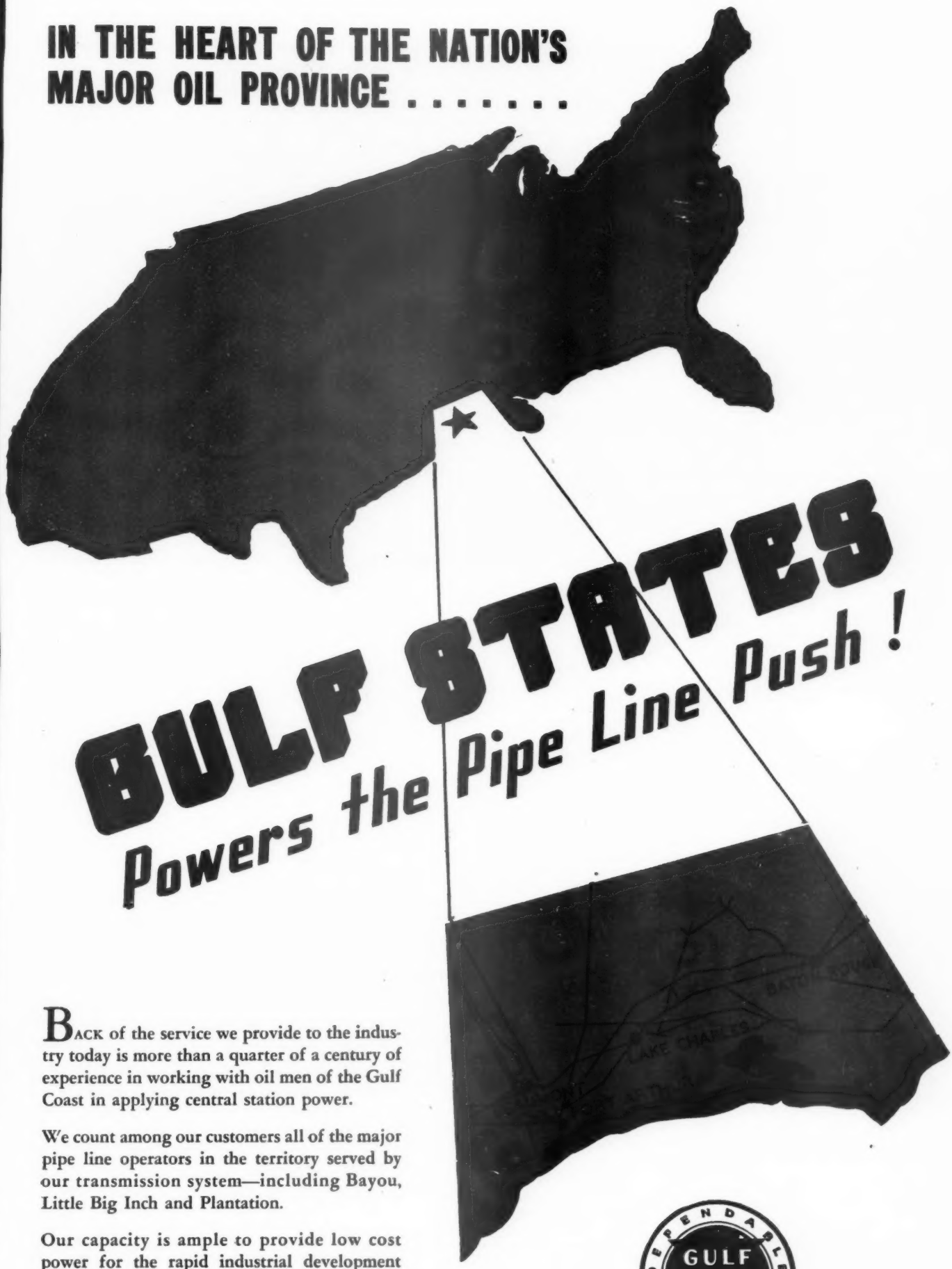
First of all, the technology of refining has become at least five times more complicated since the introduction of the new processes that began in the early 1920's. The engineers and chemists were forced out of their laboratories into executive and supervisory positions as one result of it, but the need for specialized knowledge has penetrated further and further into the rank-and-file. Take the refinery welder, for instance. In 1920 a good welder needed an apprenticeship of about four years; in 1946—and despite greatly increased stress on scientific training—the required period is the same or longer. New metals and new methods have dictated greater skill, skill recognized by management.

Not only is increasing manual skill being demanded, but more and more "know-how" in chemistry and engineering seems to be needed to keep men up to the pitch of efficiency that modern operation requires. Interviews with operating personnel of a refinery unit chosen at random showed that only 25 per cent had a basic knowledge of the chemical process employed in that unit. A "cat cracker" operator at another refinery said, "I was on this job three weeks before I found out what a catalyst was and what this one did." Though these may not be the average, more scientific instruction in both processing and maintenance is an industry-wide need.

Another reason for the coming extension of refinery training is the desire of companies to develop executive and supervisory talent among rank-and-file employes. Big working forces tend to submerge this talent, and the progressive company may find that training is the best device for making this talent recognizable.

One specific illustration was that of

IN THE HEART OF THE NATION'S MAJOR OIL PROVINCE . . . . . .



GULF STATES

Powers the Pipe Line Push!

BACK of the service we provide to the industry today is more than a quarter of a century of experience in working with oil men of the Gulf Coast in applying central station power.

We count among our customers all of the major pipe line operators in the territory served by our transmission system—including Bayou, Little Big Inch and Plantation.

Our capacity is ample to provide low cost power for the rapid industrial development taking place in this section. Inquiries are invited from firms considering locating in the territory and will be treated confidentially.

DEPENDABLE GULF STATES UTILITIES CO. PUBLIC SERVICE

"Constantly Improved"

GULF STATES UTILITIES COMPANY

GENERAL OFFICES, BEAUMONT, TEXAS—BATON ROUGE AND LAKE CHARLES, LOUISIANA

the mechanical helpers in the Magnolia Petroleum Company's Beaumont Refinery who took a night-school course in blueprint reading and sketching; their supervisors were surprised to find that these men had acquired sufficient skill and confidence to permit their taking over supervision of pipe-laying gangs in the yard. As intensive competition begins again, the industry would do well to bed the large experience of many employes in a solid foundation of methodical instruction pointing toward supervisory duties.

A third reason is management's need for counterbalancing the seniority system with the efficiency that training can bring to upgraded employes. I should like to come back to that later.

Office supervisor: Those are reasons enough, but what's being done on the practical level? If training is being accepted by refiners the next step would be plant-wide programs, it seems to me.

Training director: It might be — except for some very practical difficulties that are in the way. As a matter of fact, there isn't a single refinery on the Texas Gulf Coast — the heaviest refinery concentration point—that has a long-term training program extending to all employes. Nor, so far as I know, is there such a program anywhere in the country.

But before you ask why, I'll tell you the chief holdup in such plans — and most refineries do have their plans drawn. Without much doubt it's the present instability of union-management relationships. Remember this — that few men are willing to exercise their energy in new learning unless they have a promotion incentive to back it; but promotion among at least three-fourths of the industry's employes is governed by a "seniority clause" in the bargaining contract, which usually specifies seniority and "relative fitness and ability" as the promotional factors.

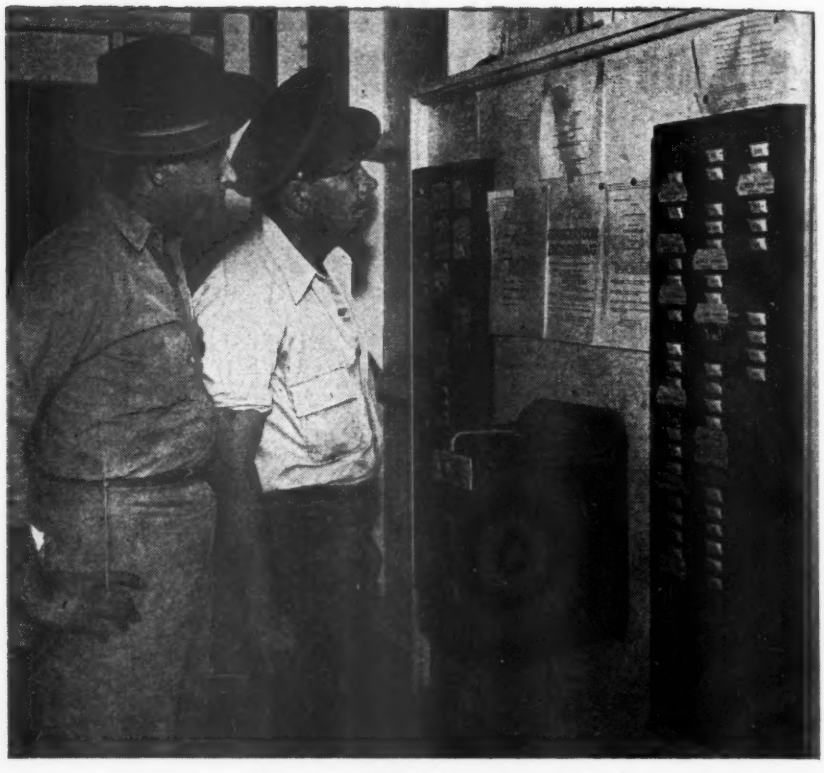
Union insistence on seniority has made that factor the prime one in 99 per cent of promotions, the exceptions being in those cases where the senior man is almost entirely lacking in ability to learn or in experience. Deprived of their chief appeal, plant-wide programs aren't likely to be looked on with favor by either management or union. Companies generally feel it's like turning on the spigot when there's no bottom in the bucket.

There is also the very practical matter of pay. Most unions insist that a trainee who learns a higher grade job by actually doing it under supervision is entitled to the pay of the higher job for as long as he is engaged in it. Few companies can afford this expense, for it results in no production increase, and the bookkeeping is both expensive and complicated.

Some companies have managed to jump these hurdles, however.

Foreman: Let's hear about those.

Training director: I suppose the biggest jump was the experiment of one large oil company in setting up a joint union - management training program that retained the seniority principle while increasing the emphasis on skill.



Company advertising of out-of-plant vocational classes increases employe enrollment in worthwhile education.

In 1940 this company and two unusually far-sighted union locals signed a contract that set out in specific, written terms the nature of the program to be instituted. Incidentally, a company official said later that this reducing the program to writing as a preliminary was the determining success factor. At any rate, the program was begun with the union contributing its most highly skilled journeymen as instructors and with the cooperation of the training supervisor and company representatives. The program extended to the craft jobs chiefly and was not given to those men who were remote from promotion.

As a result of this system, men up for promotion on a seniority basis were required to have passed exhaustive written and performance tests. The company's training supervisor reported later that the program acted as a cushion for the shocks of the wartime manpower shortage. It is, on last reports, still working well.

This compromise arrangement was studied by most of the industry, and programs on the same basic plan were drawn up in many cases. One large refiner in the Gulf Coast area is working into a plan inspired by—though differing widely in many respects—this pioneering scheme. It may yet set the pattern for the future. But the majority of these plans have been shelved, pending further stabilization of the union-company relationship.

Foreman: If that's true, then how is this training growth going to come? What's in the books for the next five years, for example?

Training director: I won't be caught saying definitely, but I might make a fairly sound guess. Training will concentrate on three things: First, broadening and intensifying training in the crafts; second, "spot courses" in individual skills, such as pump operation; third, programs to make better supervisors out of good ones.

Office supervisor: The crafts seem to have received a great deal of attention already. Will they get more?

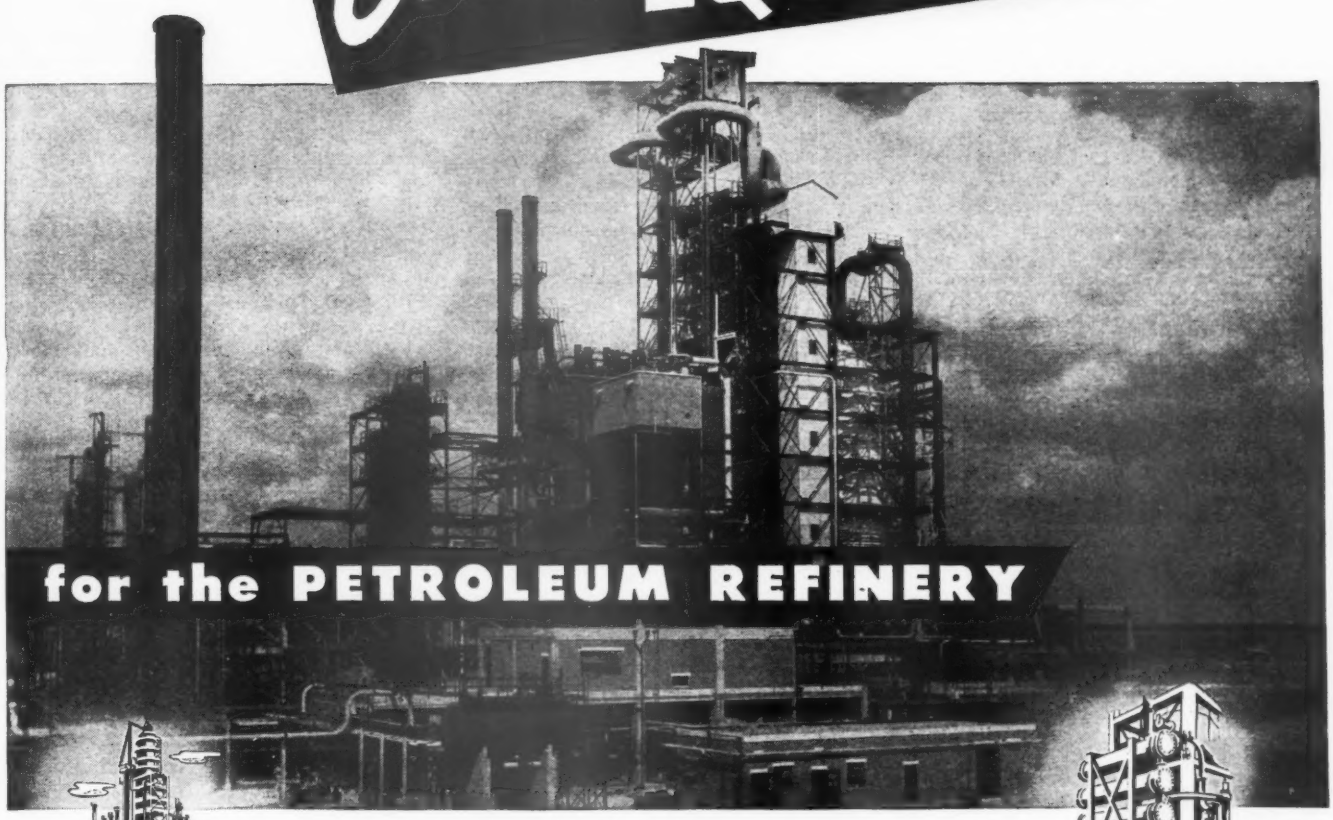
Training director: Not "a great deal" —just more than others. The crafts lend themselves to training, and results are possibly more noticeable than in process jobs.

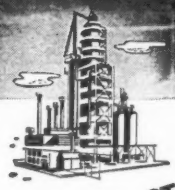
Another reason for craft emphasis is that some of their unions place value on skill and have a tradition of training behind them. Although the old idea of intensive apprenticeship training by unions has been largely forgotten, cooperation with such unions is a little easier.

In a few cases unions have taken the initiative in training their members for industry's modern needs. In 1944 and 1945 one craft sent journeymen to a university to study scientific principles under recognized authorities, and these men returned to conduct classes of their own for other journeymen. Such a progressive attitude is still unusual, however.

As for "spot courses," they were used extensively during the war and proved just the thing for training in situations

Essential EQUIPMENT

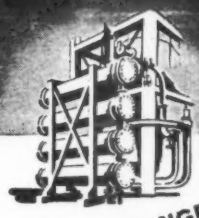




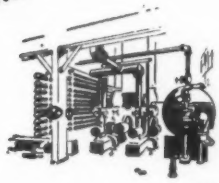
TOWERS—STILLS

STEAM BOILERS

DROP FORGED STEEL VALVES AND FITTINGS



HEAT EXCHANGERS



REFRIGERATION

WAX PLANT EQUIPMENT

REMODERNIZATION is a *must* for many refineries in order to stay in the profitable production bracket of the post-war era!

Select the process most suitable to your operating conditions and indicated future market requirements and then specify . . . Equipment by Vogt. A skilled operating personnel and exceptional manufacturing facilities assure the best in quality workmanship for the wide variety of process equipment we construct to all Codes.

Remember — Vogt will design and build it . . . better!

HENRY VOGT MACHINE CO., Inc.

LOUISVILLE 10, KENTUCKY

NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

where increased efficiency was a priority item. I mentioned pump operation as an example because one company scheduled highly successful courses in this field after it was found that refinery pumps were being worn out too fast due to improper operation. Using charts and diagrams pump design was explained and correct operation demonstrated. The idea can be applied to almost any skill—"blinding" a safety hazard, for instance, or setting up a uniform file system.

Training courses for supervisors, the third item, got a big push during the war through the widespread adoption of the "Training Within Industry" program by some 14,000 firms and industrial plants. This scientific training system was divided into three parts: Job Methods Training, Job Instructor Training, and Job Relations Training — shortened to "JMT", "JIT", and "JRT", usually. Drawn up by authorities in the training field, these courses dealt with job analysis and improvement of work methods, with the instruction of employes in job duties, and with the bettering of relations between the supervisor and the individual employe.

The experience with TWI confirmed a training axiom—that the most important thing is having well-trained instructors. And because of the success of the JIT program particularly, those companies making full use of it found that breaking-in time for new employes dropped an average of 35 to 40 per cent. Much of the TWI system is based on the conference method, an important idea that should be used more widely in the industry.

Foreman: Here's an idea that may be a little off the subject, but I want to get it in. I don't know whether I should confess it or not, but I'm up a stump too often when my men ask me about company policy. Seems to me there should be some way to keep us up on these things.

Training director: Thats not off the subject; it's right at the core of it. The idea that foremen and other supervisors are the best means of communication between company and employes is a basic factor in training. Foremen have to know the answers. That's an essential that refineries are meeting in various ways.

Company publications of all types offer one way. One very successful in this class is the policy guide used at a large Louisiana refinery. This is a loose-leaf book that carries full details of all company rules, policies, and procedures; as these are changed or modified, new sheets are issued and out-of-date ones discarded. A good index permits the supervisor quick reference to any needed information.

Another method is the conference scheme adopted by the Magnolia Petroleum Company's Beaumont Refinery. These are panels attended by all supervisors twice monthly. Groups are kept small to permit good discussion. Topics are chosen in advance and deal with such subjects as the annuity and insurance plan, veterans' rights, accident prevention, vacation and leave of absence privileges, and contract clauses. An expert in each field makes a brief preliminary explanation, and then supervisors discuss the policy, analyze it, and offer suggestions for improvement. The chief benefit of this plan, in addition to informing the participants, is providing a "sounding-board" through which supervisors can relay freely their opinions and current thought to the management.

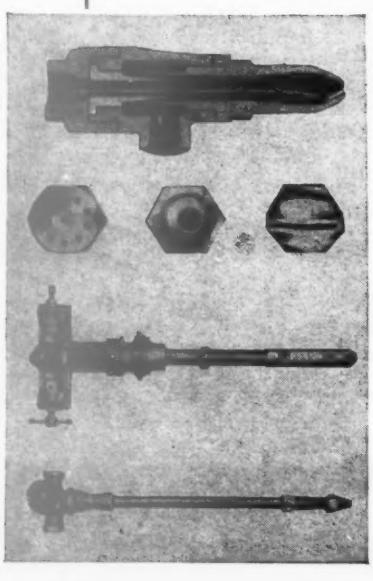
Foreman: You've been hitting the high spots in training trends, but I want to get down to cases—on my department, for instance. Suppose I want to set up my own program—how do I go about it?

Training director: I can talk all day on that, but I won't; however, the first step in deciding what type of program you need. There are two general alternatives — either a departmental project with on-the-job instruction and classwork, sponsored by the company, or outplant vocational courses that might be arranged through the schools.

If you think a company-sponsored program advisable, consider these disadvantages: (1) Costs will be relatively high, particularly if overtime is paid for classroom work; (2) if participation is compulsory, as most such programs are, your scheme may be handicapped by disinterested attenders; (3) you will have to thread your way through a contract even though you avoid the promotion and pay difficulties.

NATIONAL AIROIL FUEL OIL · GAS BURNERS

THERE'S A BURNER FOR YOUR JOB



whether you burn oil, gas or a combination of fuels, National Airoil has the right burner or combination of burners for your job.

More than 34 years' experience in the design, development and manufacture of Oil, Gas and Combination Burners for all types of industrial applications (including many in the Petroleum and Allied Industries) helps us to solve your combustion problems.

LET US HELP YOU

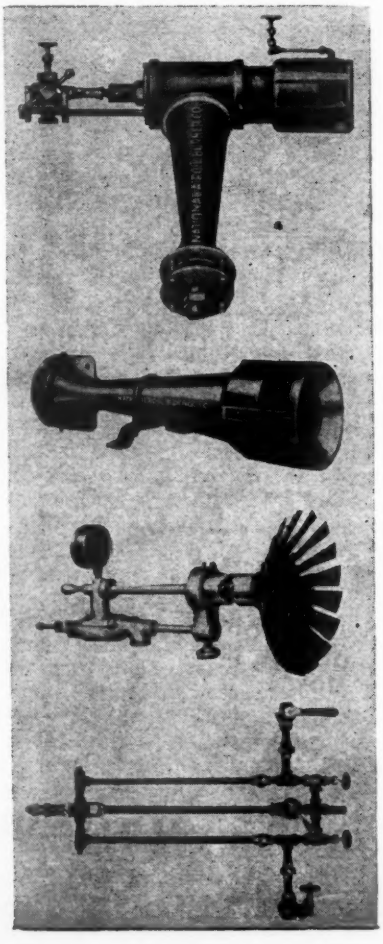
Our accumulated knowledge and experience is at your service . . . write us, *now*, about your problems . . . and we'll arrange an engineering consultation with you.

TYPE "SA" OIL BURNER
TYPE "SAL" OIL BURNER
TYPE "SAR" OIL BURNER
COMBINATION GAS AND OIL BURNER
"AIROCOOL" GAS BURNER
MECHANICAL PRESSURE ATOMIZING OIL BURNER
TYPE "S-A-D" OIL BURNER

NATIONAL AIROIL BURNER COMPANY, INCORPORATED

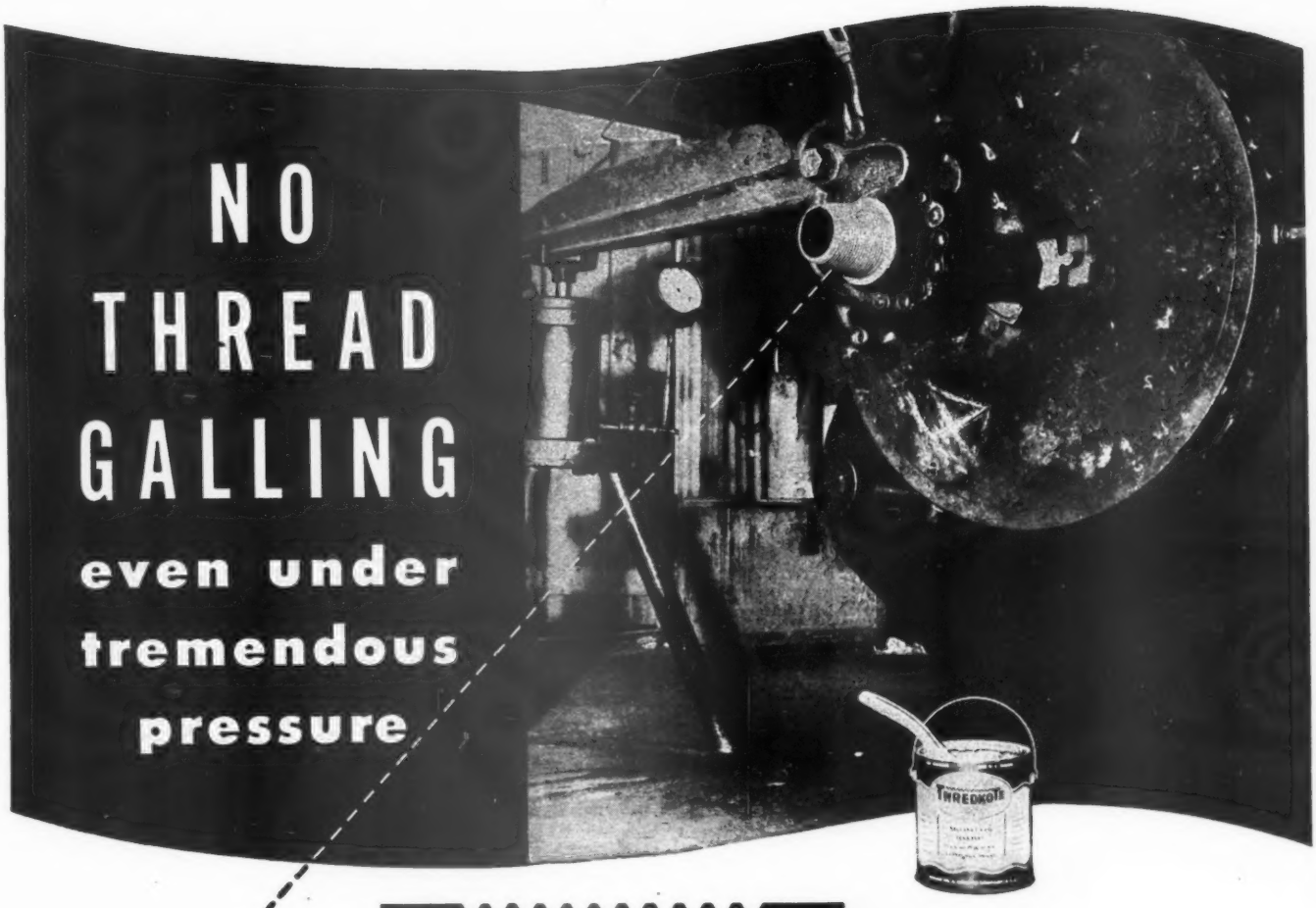
1259 E. Sedgley Ave., Philadelphia 34, Pa.
Texas Office: 2nd National Bank Bldg., Houston

INDUSTRIAL OIL BURNERS • GAS BURNERS • FURNACE EQUIPMENT



NO THREAD GALLING

even under tremendous pressure



... with THREDKOTE 701

The tremendous pressure present when tool joints are bucked on drill pipe often leads to thread galling.

Prevent this with THREDKOTE 701.

This specially developed tool joint lubricant exceeds specifications established by the major tool joint manufacturers and allows full pulling up without exceeding the allowable working torque or galling threads.

It is recommended for use also on the pin and box threads of tool joints when drilling at ordinary depths.

A complete line of THREDKOTE compounds is available for use on practically every type of threaded connection in use in the oil industry.

THREDKOTE

For information on the complete Thredkote line write Humble Oil & Refining Company, Box 2180, Houston, Texas.

Thredkote is Manufactured and Distributed by

HUMBLE OIL & REFINING COMPANY

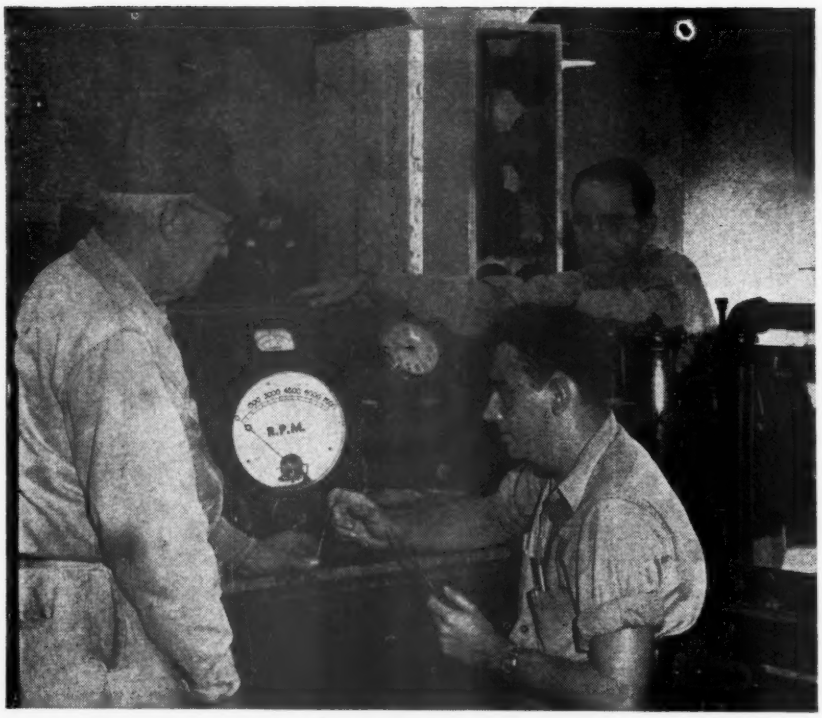
Here are some of the advantages to in-plant programs: (1) You can make a direct correlation between classwork and on-the-job instruction; (2) training can be slanted to your department's specific needs and use can be made of company equipment and procedures; (3) the level of teaching can be raised to the level of the class immediately without teaching beginners or men from other industries or plants.

So far as out-plant classes are concerned, the amount of cost varies with the cooperation that the refinery renders. In most states there are provisions in law for aiding schools in setting up vocational training programs, most of them very broad and with few limits on type of subject or instructors. Some proportion of the cost is borne by the student himself—a good thing, if the cost is reasonable, for men derive most from a course for which they have had to pay, even if only a small amount. The outside class is usually not directly connected with the company; hence, the problems of union relationship do not arise. And the volunteer system eliminates those who are not interested.

Against the school-conducted classes is the fact that they cannot be limited to employes of one company; specific slanting cannot be done, and sometimes beginners and advanced students must share a class.

Office supervisor: Then what's your recommendation?

Training director: Both of these can work well, depending upon the particular department and local conditions. I'd like to tell you, however, about how these were compromised in a very successful solution at Magnolia's Beaumont Refinery.



Thorough on-the-job instruction is a routine for new men at the instrument shop of Magnolia's Beaumont refinery.

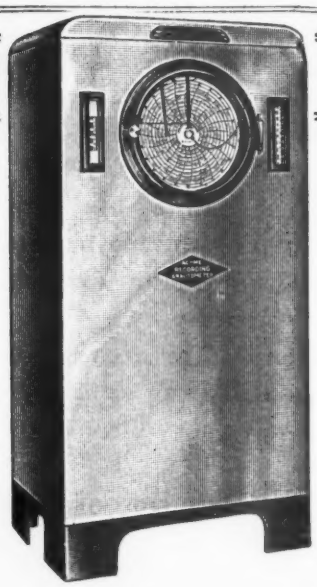
The foreman of the instrument shop, in addition to knowing instruments, has long been convinced of the merits of organized training. When a local college —a two-year school with an above average corps of instructors—began a vocational program, it was suggested that courses in instrument work be given.

AC-ME RECORDING GRAVITOMETER

Complete Visibility—

This instrument accurately records the changing gravity of gas and automatically corrects for variation in barometric pressure and temperature.

Sturdy construction and simplicity of operation contribute to accurate operation with a minimum of maintenance.



—Extremely Sensitive

The instrument does not contain rotating parts thereby eliminating a major source of wear and the accuracy and practicability of Refinery Supply Company equipment are the result of scientific and sound manufacturing procedures combined with materials of proven integrity.

Write for Catalogue No. 30-A

THE REFINERY SUPPLY CO.

Main Office and Plant

621 E. 4th Street **TULSA,3,OKLAHOMA** Ph. 4-8144, L.D. 581

Houston Office Temporarily Discontinued

DURA PLASTIC

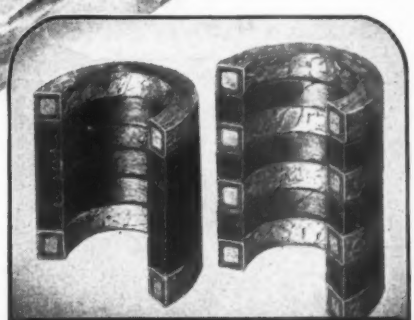
a general purpose packing

HERE IS A DEPENDABLE Semi-metalic packing for general use in your plant . . .

Dura Plastic is constructed of selected metallic shreds, fibres, lubricants and special binders. It provides an improved stuffing-box service for water, air, steam, gasoline, oils, and chemicals. Effective on temperatures from –50° F. to 900° F.

DURA PLASTIC FEATURES:

- **Economical**—*low first cost, low maintenance.*
- **Pliable**—*forms around shaft without "breaking."*
- **Resilient**—*retains resiliency and lubrication.*
- **Metallic**—*metallic shreds reduce frictional wear.*



DIE-MOLDED RING SETS. Also available in combination with end or alternate rings of Durametallic metal foil packing.

BULK DURA PLASTIC. Consists of long asbestos fibres and metallic shreds adequately lubricated throughout. Contains a special resilient binder.

FREE ENGINEERING COUNSEL
ON YOUR PACKING PROBLEMS

The PERFECT SEAL

DURAMETALLIC CORPORATION

KALAMAZOO MICHIGAN

CHICAGO • DALLAS • DETROIT • HUNTINGTON, W. VA. • HOUSTON • KANSAS CITY, MO. • LOS ANGELES • MONTREAL
NEWARK • NEW ORLEANS • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SALT LAKE CITY • TULSA • YOUNGSTOWN, OHIO

Such specialization was deemed necessary because of the heavy concentration of refineries in the area served by the college. The foreman found that most of his instrument men would be interested in such courses, cooperated with the college in setting them up, and was himself asked to serve as instructor.

The courses planned were in electronics and instrument maintenance and repair. The foreman encouraged participation in them among his own men, and about 95 per cent registered for the classes over a period of several years. By teaching the classes himself, and by the full cooperation of the Magnolia plant in lending equipment, he was able to render a high standard of instruction to students from all refineries and industries along the lines he knew to be practical. Magnolia's students benefited, of course, from use of plant equipment.

Commenting upon this plan, the foreman says, "It has worked better than I had hoped—men who hold a first-class rating from this shop would be accepted as such by any refinery in the Mid-Continent area. The ideal system, I think, would be to have local industry supply all instructors and equipment with the schools furnishing only classroom space and financial help."

Incidentally, this foreman believes that one big advantage in collaborating with a college is the psychological appeal of the word "college"; it has greater "pull" and morale value than do in-plant courses.

Office supervisor: Magnolia happened to be lucky in having a college close by. That isn't true for many refineries.

Training director: I think you'd be surprised on that. Where there's heavy industry there's usually a college. Small schools, which often specialize in vocational classes, are usually well equipped for it. We are slated to see more and more use being made of them by the refining industry, I think.

If there is no college, however, high schools can be of great help, particularly in the training of new men. A talk with a local schoolman can settle all these questions; most schools are anxious to cooperate with large employers in their area.

Office supervisor: In plant or out-plant, what types of teaching methods are coming in? How about this visual education that has had so much publicity?

Training director: Visual education will unquestionably expand. The idea behind it, of course, is that a person remembers what he sees better than what he hears. Prior to the war, its use by the petroleum industry was second only to that of the automobile industry. It seems slated to continue and grow in the refining industry where before its use was somewhat limited.

Don't get the idea it is a fundamental though. Most educational experts agree that it is a valuable auxiliary to personal instruction of other kinds. Motion pictures, slides, charts, working models —these and other types can best be used to illustrate points brought out thoroughly by a good instructor.

One of the things that should take priority in this field is the making of more films and prepared visual material for the specific use of the refining industry in teaching fundamental job skills. Such an expansion might well come from a united project — possibly through API.

While on the subject of methods, I want you to notice the increasing use of what might be called the "rotation system" in many refineries, particularly in offices. It is based on the truth that men, no matter how well trained, tend to grow stale on one job over a long period of time. Simple in execution, it advises regular rotation of personnel to new duties within a department or office.

Experience with this scheme in the technical department of Magnolia's Beaumont Refinery and in other departments indicates that it has real value in training new engineers and halting job-fatigue, at the same time developing a versatile personnel force. It may be elaborated upon with further training, of course.

This one last tip — before beginning any kind of departmental training program, have it thoroughly mapped out with objectives fixed, methods determined, and materials and instructors ready. Planning with foresight will pay off in high effiicency percentages, stimulated interest, and improved morale. ★ ★

AMERICANS have been handling weighty matters in heavy industrial machinery and oil country equipment for more than a quarter of a century. Leading manufacturers prefer AMERICANS because they are designed especially for smooth, dependable service in the heaviest, most powerful equipment built. Their simple construction, absolute precision and tremendous strength assure longer, safer, lower cost, trouble-free performance under the most abusive operating conditions to be found in modern industry. For your next heavy-duty installation specify AMERICANS. Write today for complete technical data.

AMERICAN ROLLER BEARING COMPANY
PITTSBURGH, PENNSYLVANIA
Pacific Coast Office: 1718 S. Flower St., Los Angeles, California

AMERICAN
Heavy-Duty ROLLER BEARINGS

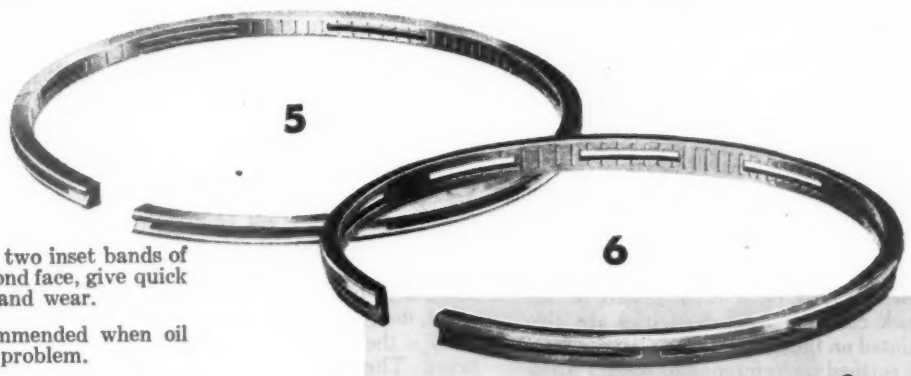
For QUICK SERVICE on Replacements

For LONG SERVICE from Replacements

1 TAPERED COMPRESSION RING. Seats in readily. Highly effective in preventing blow-by.

2 STEP SEAL RING. Probably most effective one-piece sealing ring available. Widely used.

3 OUTER SEAL RING. Excellent in preventing blow-by in both new or worn cylinders.



4 GOLD SEAL RING. One or two inset bands of bronze, projecting .002" beyond face, give quick initial seat, reduce scuffing and wear.

5 OIL CUTTER RING. Recommended when oil control has become a major problem.

6 SCRAPER DRAIN OIL RING. One-piece, concentric, quick-seating ring, designed to ride over the oil on the cylinder wall on upstroke of piston, scrape oil into groove on downstroke.

Available

THROUGH THESE DISTRIBUTORS

LONG BEACH Birger A. Guthe 1214 E. Anaheim St.	**TULSA** Nolan Sales Corp. 404 E. Second St.
FORT WORTH J. M. Fuller 3725 W. 7th St.	**HOUSTON** W.P. Cunningham Co. 4913 Leeland Ave.

K KOPPERS

American Hammered Piston Rings

KOPPERS COMPANY, INC., BUSH & HAMBURG STS., BALTIMORE 3, MD.

Oil accounting

By **JACK D. FARNAN,** General Petroleum Corporation

PART 2 (Conclusion)

● **Transportation.** Crude oil is moved off the producing property to the refinery by the most economical means available. This might be pipe line, tank truck, or a combination of these methods.

EXCLUSIVE

When moved by pipe line the crude oil is gauged and sampled in the lease shipping tank and a run tag prepared recording the delivery to gathering lines. Gathering lines are laid into the oil field for the purpose of collecting crude oil from the lease and delivering it to the main line. When gathering lines and main lines are owned or operated by the same company it is not customary to obtain a measurement of the oil out of the gathering system into the main line. Receipts into the gathering system are deemed the same in quantity as deliveries to the main line—gathering lines being full before and after delivery. Occasionally deliveries are made out of the gathering system to sales or usage. Such deliveries must be recorded on run tags and netted out of receipts to determine the quantity reaching the main line.

The quantity of oil delivered by tank car or tank truck is usually determined by the rated capacity of the equipment. Certified truck capacities are stenciled on the side of the truck and/or trailer and reflected on a card posted in the truck cab. Tank car capacities are also painted on the side of the cars and should be verified by reference to Kipp's Tank Car Tables and supplements thereto. A combination Run Tag-Bill of Lading can be used to good advantage in recording these deliveries.

The quantity of oil delivered by tank ship is determined by measurement of the oil in the ship's tanks. Shore tank gauges should also be obtained for checking purposes. Deliveries by tankers are recorded on a special tanker loading tag. This marine tag should be serially numbered and provide space for the plant loading, name of the vessel and owners, registry, voyage number, berth number, time docked, time pumping began, fore, aft, and mean draft light, time pumping finished, fore, aft, and mean draft loaded, and time vessel cleared the dock. It should provide six or seven spaces to record long and short gauges in the various ship's tanks and in addition space for, extending the tank measurements to net barrels and long tons. Deliveries should be receipted for by the responsible officer of the vessel and witnessed by the agent of the deliverer. If the volume of business warrants it, separate forms of loading and unloading tags are advisable. At the out-turn side of a marine haul the quantity received is that measured in shore tanks. The difference between quantity loaded per ship tank gauges and quantity received per shore tank gauges is considered as a transit loss and is so recorded.

Invoices covering transportation of oil are passed to the oil accountant who verifies the rates, ascertains that the products have been moved, and approves for payment.

A complete and accurate record of oil movements through gathering and main pipe lines must be maintained for the purpose of computing and paying the federal pipe line tax.

Another effective and economical method of moving oil from one point to another, at least in effect, is through the medium of exchanges. When one company has an excess of, say, crude oil at one location and a deficiency at some other location and another company is in a reverse position an exchange of products can be arranged to the mutual advantage of both. Agreements covering the exchange of products should be explicit and should avoid ambiguity. They should allow transportation differentials where appropriate and delineate the method of balancing the exchange. Another item that sometimes causes difficulty is the matter of personal property taxes. The agreement should state whether such taxes assessed against the possessor on tax date of oil that is owed to another company on exchange may be passed on to the owner of the oil.

Exchange agreements can be very simple when they cover only two points and are on a barrel-for-barrel basis, or they may be extremely complicated when they encompass many points and the crude oil or other products exchanged differs widely in quality and constituents. An exchange agreement of this latter type may, as an example, state that balancing will be accomplished on the basis of the 400° end point gasoline contained in each company's receipts. Representative composite samples of each company's receipts each month are collected and tested by Badger Distillation method to determine the content of 400° end point gasoline (cut No. 1), gas oil (cut No. 2), and 100 sec. viscosity fuel oil (cut No. 3). When the quality of cut No. 1 from the two samples differs the deficiency is made up in natural gasoline and balanced in fuel oil. The quantities of cuts 1, 2 and 3, and natural gasoline are recorded in supplemental exchanges.

Sometimes exchange agreements call for balancing on the basis of the value of each companies receipts at posted market prices. Such exchanges may be balanced by an exchange of money or the delivery of a greater quantity of oil of a lesser value against the receipt of a lesser quantity of oil of a greater value.

Whatever the method used in balancing, it is common practice for companies having exchanges to exchange confirming letters regarding the balances at the close of each month so that differences may be reconciled while current.

● **Refining.** Crude oil received at the refinery from pipe lines is measured in the receiving tank and a run tag prepared recording the receipt. It is customary to permit a finished crude tank to stand at least 8 hr. before gauging and sampling. In those cases where a good water gauge is unobtainable the quantity of water in the tanks is determined by sampling the wet bottoms and obtaining an M. & B. S. cut for the bottoms. A representative sample of the remainder of the tank is obtained and the M. & B. S. percentage determined. All measurements are extended to net barrels of oil at 60° F.

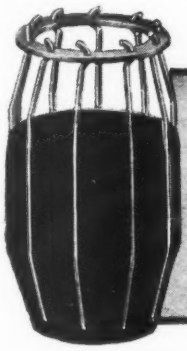
The oil accountant must work closely with the operating department in devising a form for compiling the daily report of operations for each of the various processes at a refinery. With proper planning a single form can be made to serve the needs of both the operating department and the accounting department. The oil accountant is primarily concerned with the net barrels of each commodity charged to each process and the net barrels of each commodity recovered from each process, with the resultant process loss or gain.

The crude oil charge to the primary distillation units is determined from gauges reflected on the pumper's and/or stillman's report. The quantity of rerun products charged to primary distillation is similarly determined. The yields of various liquid products are also determined from gauges reflected on the pumper's or stillman's reports. The yield of still gas is measured by orifice meter and the meter chart is read to determine the volume of still gas in cubic feet. This still gas must then be converted to barrels of charge stock on a weight basis. The per barrel weight of the charge stock, when the API gravity is known, is determined by referring to Table 5, National Standard Petroleum Oil Tables (National Bureau of Standards Circular C-410). The total weight of still gas metered, determined by laboratory analysis divided by the per barrel weight of the charge stock, gives the equivalent barrels of still gas. The difference between the barrels charged and the barrels yielded is recorded as a process gain or loss as the case may be.

The procedure to be followed in pre-

TOP PERFORMER *in every field*

Built to carry more fluid at every stroke, the Type "K" Swab gives championship performance in every type of well, deep or shallow. It's the *only swab that utilizes the correct swabbing principle.* The cup continues to make a perfect seal as it automatically takes up its own wear. Ample bypass area through mandrel combined with flexible cup insures fastest falling. Compact and simple, removal of only one nut is required to change cups. Guiberson Type "K" Swabs are made for every tubing and casing size.



***flexible* BASKET" CUP**

Flexible spring steel wires hold cup shape and increase cup life. Moulded-in steel bushing takes greatest portion of lift-load. Cups are made of oil resistant compound, which has great resistance to abrasion and the high strength necessary for swabbing requirements.

TYPE "K" TUBING SWAB —Two-cup unit on a one-piece mandrel with integral valve body and full opening ball valve and bullet-nose retaining nut. Made in all tubing sizes from 1½" to 4".

TYPE "K" CASING SWAB— Is equipped with ribbed, streamlined check valve to give least resistance when entering fluid and afford positive guide when running in the hole. Made in all casing sizes from 4½" to 13⅜" O.D.

Established 1919

Reg. U. S. Pat. Off.

Guiberson U. S. A.

THE GUIBERSON CORPORATION

DALLAS, TEXAS

California Distributor: The W. R. Guiberson Co., 717 East Gage Avenue, Los Angeles, California.

Export Representative: Oilfield-Industrial Export, Inc., 30 Rockefeller Plaza, New York, New York.

Branch Offices in Oklahoma City, Okla.; Longview, Texas; Kilgore, Texas; Houston, Texas; Alice, Texas; Odessa, Texas; Wichita Falls, Texas; Lafayette, La.; Newark, Ohio.

paring the process report for each of the other processes at a refinery, such as viscosity breaker, reformer, cracking plants, coker, etc., is essentially the same as that described for primary distillation.

The usual run and yield reports on a volumetric basis for a refinery where operations comprise both cracking and polymerization can be valueless, or worse still, definitely misleading. Yields from cracking processes on a volumetric basis normally will exceed the total barrels charged to such processes. Yields from polymerization processes on a volumetric basis normally will be considerably less than the barrels charged. Loss or gain figures that net volumetric shrinkage or expansion with physical losses or gains will certainly, insofar as the operating department is concerned, be just a bunch of numbers. The solution is to provide process reports on a weight basis as well as on a volumetric basis.

The matter of providing a weight balance on runs and yields poses no difficult problem for the oil accountant provided he is supplied with accurate laboratory information on the gravities of liquid products and weights per cubic feet of gas produced. The use of weight balance process reports does require the utmost accuracy in obtaining and testing proper representative samples of products. When the API gravities of products yielded is known the weight can be determined by referring to Table 5, Circular C-410 (as mentioned above). The total weight of products yielded from a process is deducted from the total weight of the charge to the process to determine the weight loss or gain. The weight loss or gain is converted to barrels of charge stock by dividing by the per barrel weight of the charge stock. This barrel figure is then shown on the volumetric yield report and identified as a process loss or gain. The figure then required to balance the volumetric run and yield report is identified as loss or gain due to shrinkage or expansion.

The process reports should carry, in addition to daily runs and yields, figures accumulated for the month to date. The final report for the month then constitutes a summary of operations for each process for the month.

A daily report of oil in storage is compiled by the oil accountant from measurements supplied by the gauger's report. The form used for this storage report should be columnar, providing space for commodity, tank number, API gravity, overall and water gauges, gross oil, temperature, M. & B. S. percentage, and net oil. This report is of considerable interest to the operating department and copies of it should be placed in the hands of the operating management as early in the morning as possible. The final report for the month represents the barrels of oil in storage at that location for which values are carried on the general books of the company.

A daily report of oil movements is compiled by the oil accountant. This report records the commodity, source, and quantity of all receipts, and the commodity, destination, and quantity of all deliveries for the previous 24 hr. A form of daily oil movement report that has been found particularly useful is one that lines up with the tank set-up on the daily oil storage report. It is then possible to place the opening storage report (previous day's closing) on the left side, the daily oil movement report in the middle, and the closing storage report on the right side and develop the storage loss or gain for each tank. Receipts from sources outside the refinery and deliveries to destinations outside the refinery should be supported by signed run tags. Runs and yields as picked up on the daily oil movement report are supported by process reports, which in turn are supported by pumper's and/or stillman's reports. Transfers between tanks are supported by pumper's reports. The daily oil movement reports are posted daily to monthly recapitulation sheets. These monthly recaps are totaled at the close of the month and the totals used to develop monthly oil movements for costing purposes.

This appears to be a good place to again emphasize the fact that the accuracy of the oil accountant's reports and records are absolutely dependent upon the accuracy and adequacy of gauging, sampling, and laboratory determinations from samples. The extent to which the company stands to suffer financial loss from inaccurate gauges and poor sampling technique will usually prove to be the yardstick upon which the expense of guarding against these inaccuracies is measured.

● **Absorption plant.** Wet gas produced from oil wells is metered into the gas gathering system. The meters are so placed as to provide measurements needed to satisfy royalty and other contractual obligations. Also, when the components of wet gas from certain wells differ widely from that of other wells, even though on the same lease, it is advisable to obtain separate measurements. Representative samples of wet gas passing through each meter are obtained by the gas laboratory for testing.

The wet gas delivered from the gas gathering system to the absorption plant is metered through plant master meters. The difference between the measured volume to the gathering system and the measured volume to the plant is considered as wet gas line loss, assuming, of course, that there were no other deliveries out of the gathering system.

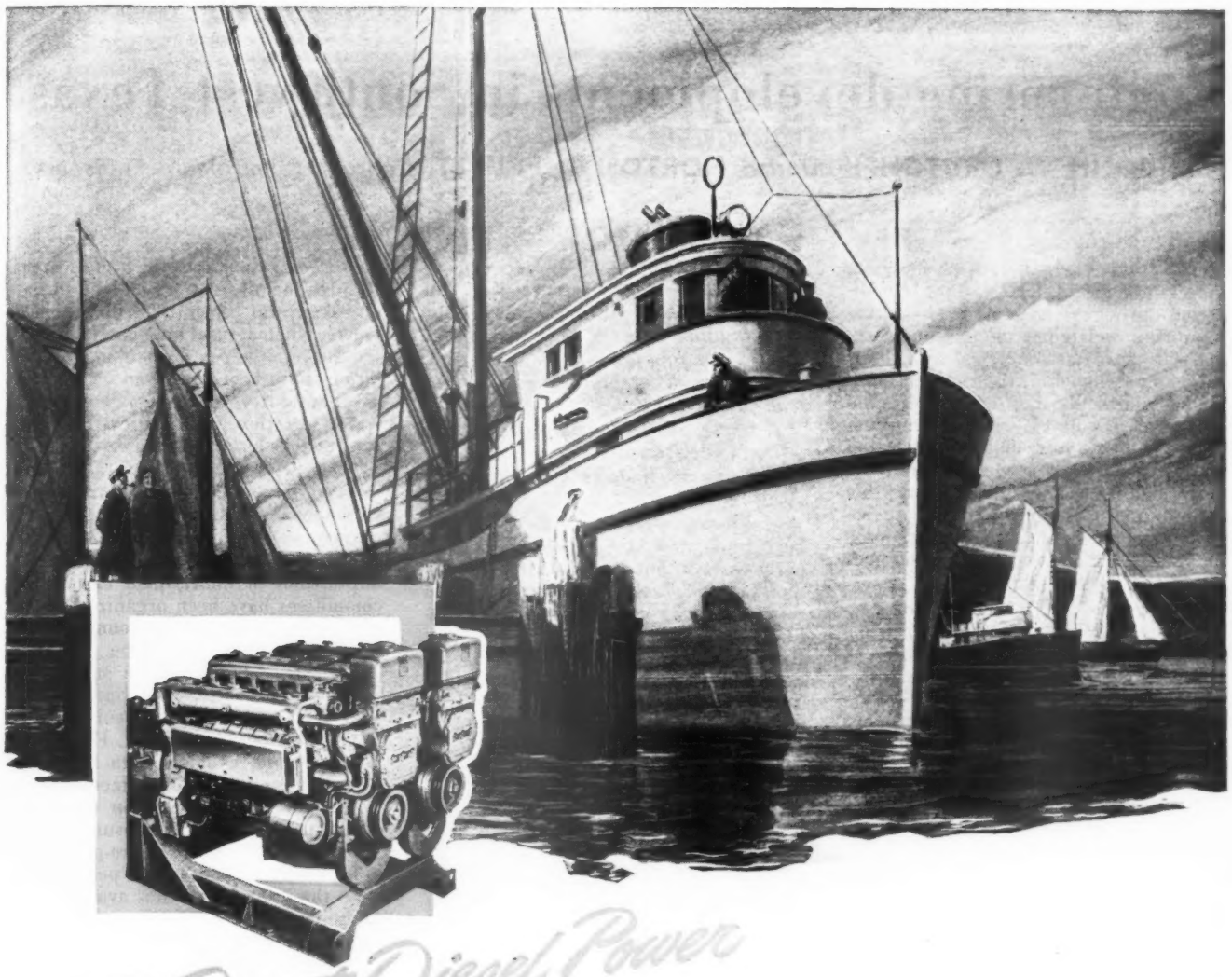
The gas laboratory supplies the oil accountant with the results of the tests of wet gas samples. These results give the natural gasoline content in gallons per thousand cubic feet for each sample as well as the content of other hydrocarbons being separated at the plant, such as propane, isobutane, normal butane, or mixtures of these liquefied petroleum gases if that is the way they are shipped.

The plant master statement is prepared by the oil accountant on a monthly basis. The potential natural gasoline contained in the wet gas delivered to the gathering system is determined by applying the appropriate content test to the separately metered volumes and totaling. The actual production of the plant is determined by qualifying the total shipments out of the plant by the inventory fluctuation. The ratio of actual production to potential production, termed plant efficiency ratio, is determined and the potential is used as the basis for distributing actual production back to property of origin. Similar treatment is accorded the other liquid products separated at the plant.

Residual dry gas is that volume metered to the dry gas disposal system. The difference between wet gas to the plant and dry gas to the disposal system is considered as due to the extraction of the liquid products and is termed shrinkage. Shrinkage is charged back against wet gas from various leases on the basis of the natural gasoline and other liquid products extracted from the gas. All deliveries out of the dry gas system are metered, including dry gas blown to the atmosphere. The difference between the volume of dry gas to the disposal system and that delivered out of the system is considered dry gas line loss. Plant fuel and line losses are charged back against various leases on the basis of wet gas delivered to the gas gathering system. Some wet gas treating agreements place a limitation on the volume of dry gas that the plant operator may use free of charge. When the prorated volume exceeds the maximum provided for in the contract such excess must be paid for by the plant. Dry gas returned to the property of origin for lease operation or drilling fuel is charged against the wet gas produced from that property. Dry gas available for sale is determined for each lease by deducting from the wet gas to the gathering system the shrinkage, plant fuel and line losses, and dry gas returned to the lease. Dry gas sales are prorated back against dry gas available for sale and the difference should balance the volume of dry gas blown to the air.

Royalty provisions applying to the products of wet gas differ widely in various sections of the country. In some places it is customary to make settlement at a fixed rate per 1000 cu. ft. of wet gas. In California settlement is based upon the sales value of the products of wet gas, with the lessor granted the privilege of taking such products in kind. The royalty rate for liquid products of wet gas is usually stated as a certain percentage of 40 per cent of the sales value—the 60 per cent of the sales value being allowed the plant operator as the cost of producing and selling. Some leases provide the royalty percentage of sales value less the actual cost of producing and selling. Here again, a close study of the royalty provisions of each agreement covering leases supplying wet gas to the absorption plant is imperative. ★★★

This is the concluding part of Mr. Farnan's article.



For Great Diesel Power

—set your course by the fisherman

FISHERMEN make their money by getting back fast with the most fish at the least cost. There's no profit in hauling around big, heavy engines that take up a lot of room.

So every day sees more and more General Motors Diesels going into fishing boats. And for good sound reasons.

These Diesels pack more power in less space—weigh less than older types. *So GM-powered boats carry more fish.*

GM Diesels get efficient combustion from low-cost fuel—keep going day after day with the least maintenance.

Add these features to the reduced fire hazard, easy starting, quick availability of parts and service, and you see that GM Diesels have features that are valuable everywhere power is needed. That is why they're taking over so many jobs that Diesels never handled before.

In the oil fields they provide flexible power. They are easy to move and use readily transported fuel. They make drilling faster and more profitable. Be sure to look to GM Diesels.

GM
GENERAL MOTORS
DIESEL POWER

Features of GM Diesels Important to Every User of Power

QUICK TO START on their own fuel

ECONOMICAL—run on low cost fuel

EASY TO MAINTAIN—clean design plus accessibility

LESS FIRE HAZARD—no volatile explosive fuel

COMPACT—readily adaptable to any installation

SMOOTH OPERATION—rotating and reciprocating forces completely balanced

QUICK ACCELERATION—2-cycle principle produces power with every downward piston stroke

DETROIT DIESEL ENGINE DIVISION
DETROIT 23, MICH. • { SINGLE ENGINES . . Up to 200 H.P. / MULTIPLE UNITS . . Up to 800 H.P.
GENERAL MOTORS

GENERAL MOTORS CORPORATION
DIESEL ENGINE SALES, PETROLEUM INDUSTRY · 1504 PHILTOWER BUILDING, TULSA 3, OKLA.

Engineering developments in Southwest Texas*

By **JOHN W. CRUTCHFIELD** and **HORTON T. PRUETT,** *Consulting Petroleum Engineers*

● **Abstract.** The activities of many engineers in Southwest Texas have been directed during the last few years toward improving well completions and working with problems concerned with reservoir engineering. Techniques for meeting the peculiar field conditions found in the area are being developed, and organizations are being built up to provide the necessary data for studies of reservoir performance in many fields. During this same period, plants using new processes have been constructed or proposed for the area, which are of considerable significance to petroleum engineers.

DEVELOPMENT and application of new processes and techniques in petroleum and chemical engineering in Southwest Texas during the last few years has been of some significance to the petroleum industry. The rapid development of fields and high oil producing rates has also increased the number of problems encountered in oil and gas production operations.

All types of reservoir conditions and reservoir drives are found in this area; however, predominant in number are fields having multi-sand conditions that are characterized by relatively thin oil columns that are overlain by gas caps and/or underlain by water. One of the principal problems encountered has been the isolation of oil productive sections in the initial completion of wells. Specific conditions that apparently lead to completion difficulties include:

1. Low productivity oil pays where extreme pressure drops are created by high producing rates.

2. Thin sand conditions with gas and/or water bearing formations adjacent to the pay.

3. Sloughing shale formations that cause irregular hole conditions.

4. Multi-sand conditions where it is desired to case-off the lowest sand and to complete in sands several hundred feet above the casing seat.

The practice in many well completions has been to isolate the producing formation by precautionary squeeze cementing above and below the final completion interval. This method has not, in many cases, resulted in successful completions, and it has also increased well completion time. Often, where multiple squeeze cementing jobs have been applied to producing zones, it appeared that the productivity of such zones were diminished, particularly where these squeeze jobs were isolated by previous cementing and high final squeeze pressures were used. Because of the only moderate success in squeeze cementing, attention has been directed toward improving primary cement jobs. Intensive work has been done and improvements in primary cement jobs have resulted from:

1. Controlling hole size before setting casing through careful control of drilling mud filtration rates.

2. Using wall scratching and casing centering devices.

3. Using muti-stage cementing devices.

Multi-stage primary cementing had been attempted in Southwest Texas as early as 1936 but unsatisfactory results in effecting a seal at the cementing tool discouraged its use as a standard technique in cementing in multi-sand fields. Basic requirements of a satisfactory multi-stage cementing tool appear to be a positive mechanical means that provides for closing the cementing ports after the cement is placed, and a method of separating the initial stage of cement and the displacing fluid, which will insure that uncontaminated cement will be left in the pipe below the float collar.

A new tool was developed last year* and has been used in 21 wells in Southwest Texas. The mechanical operation of the tool has been successful in all wells, and no failures of the tool to seal-off have been noted. There has been, however, considerable difficulty in separating the initial stage of cement and displacing fluid, which leaves contaminated cement inside the pipe. A plug or wiper for separating the mud and cement is being developed at this time. As most of the wells in which the tool has been used have been completed opposite the first stage of cement, no conclusions have been drawn on the success of the tool in eliminating squeeze cementing jobs. The operators do feel, however, that they will benefit from the multi-stage cementing in making future recompletions in shallower sands, and also from possibly eliminating migration behind the casing between upper formations.

The use of both vertical and rotating wall scratchers have helped in this area in improving primary cement jobs. Although their success in eliminating squeeze cementing in well completions is difficult to evaluate, instances have been reported where successful completions have been made as high as 800 ft. above the casing seat where both gas and water sands were adjacent to the pay.

Caliper loggings of the open hole adjacent to oil sands in certain Southwest Texas fields has indicated that there may be some connection between irregular hole conditions and the quality of primary cement jobs. These fields are characterized by numerous thick shale breaks through the oil sand, which tend to wash out to several times the drilled hole diameter when natural mud is used in drilling through the pay formation. Hole conditions have been improved by resorting to chemically treated mud to reduce water filtration, and improved primary cement jobs have been indicated.

Along with the studies of well completions, there has been an apparent trend in Southwest Texas during the last two years toward placing greater emphasis on reservoir engineering. To eliminate duplication of effort, field engineering committees have been organized in four of the largest fields, Tomoconner, Seeligson, Willamar, and Stratton. The committees are made up of an engineering representative from each operator and usually an engineering consultant is retained to assist in the work. Factual engineering and geologic data have been compiled including subsurface pressure information and production data. The committees coordinated subsurface pressure work, and joint pressure-produciton bulletins have been issued periodically. With the information thus available, the committees have been in a position to project such work as reservoir studies, pressure maintenance programs, studies of maximum efficient rates of production, and revisions in field rules. The actual expenses of carrying on this work through field engineering committees are nominal and it is believed that the work has progressed faster and with better understanding than it would have through the separate efforts of the various operators.

Among the industrial and chemical engineering developments in Southwest Texas that have or will have an effect on the oil and gas industry of the area are the proposed Carthage Hydrocol, Inc., Fischer-Tropsch plant at Brownsville, and the Celanese hydrocarbon plant at Bishop.

Perhaps the most interesting and revolutionary development is the proposed Carthage Hydrocol, Inc., Fischer-Tropsch plant. The plant will process 64,000,000 cu. ft. of dry gas per day and manufacture from this raw product 5869 bbl. of 80-octane gasoline, 1164 bbl. of 45-50 cetane diesel fuel, and 70,000 lb. of alcohols. It is interesting to note that the extraction of gasoline and diesel fuel amounts to 3.84 and 0.78 gal. per 1000 cu. ft. of dry gas, respectively.

A historical review of the Fischer-Tropsch process reflects that a reaction was discovered in Germany about 23 years ago for the synthesis of gasoline and oil from "water gas." The German government, faced with a dwindling pe-

*Presented at A.I.M.E. meeting, Galveston, Texas, October 3, 4 and 5, 1946.

*By Halliburton Oil Well Cementing Company.

Field men said...

"We want a Hose with 'GUTS' and 'GIVE'"

...and Thermoid produced it!

Like all Thermoid Oil Field Products "Powerflex" Flexible Discharge units (built like Powerflex Rotary Hose) are engineered for the job. Every single requirement for successful, uninterrupted operation has been taken into consideration in its construction. A tough neoprene tube and a stout abrasion-resisting neoprene cover, with a precision multi-ply body construction, reinforced by high carbon steel cables gives this hose the "guts and give" capable of withstanding pressures and pulsations far in excess of those normally encountered in operation. Stock assemblies are available in standard lengths of 10 feet, 12 feet and 15 feet in I.D. of 2½ inches and 3 inches with Full-Flow Pressure Seal "built-in" couplings.

Write for complete descriptive catalog on Rotary and Discharge Unit Hose. Form 3009.

THERMOID FLEXIBLE DISCHARGE UNIT HOSE

ROTARY BRAKE BLOCKS • WOVEN OIL FIELD BRAKE LINING • SHEET PACKINGS • ROTARY HOSE • SLUSH PUMP HOSE • FLEXIBLE DISCHARGE UNIT HOSE • PRODUCTION AND REFINERY HOSE OF ALL TYPES • V-BELTS AND DRIVES • OIL COUNTRY BELTING • STUFFING BOX RINGS • "NO WIP" LINE SAVER • WIRE LINE TURN BACK

Thermoid Rubber

GREEN BAY, WIS. GAVE LAYNE A BIG *OK*

Green Bay with her progressive business leaders, expanding population and rapidly growing industries has given a big OK to Layne Well Water Systems. With only one minor exception, all water producing equipment for the city bears the famous and always dependable name of Layne. That same foresighted preference which guided city officials was also true with her industries—Warehouse and Cold Storage Plants, Paper Mills, Public Service Companies, Breweries, Creameries, Milk Plants, Laundries, Soap Manufacturers, Food Processing Plants, Religious Charities, County Institutions, and many others.

The choice of Layne Well Water Systems was based upon proven performance and a definite knowledge of low operation cost. But in and near Green Bay, as elsewhere, Layne sturdy quality was not an overlooked factor.

Layne high efficiency Well Water Systems are precision built to very rigid standards of excellence. They embody the finest engineering features yet developed. For further convincing facts about Layne Well Water Systems and Layne high efficiency Vertical Turbine Pumps, write for literature. Layne & Bowler, Inc., General Offices, Memphis 8, Tenn.

HIGHEST EFFICIENCY

Layne Vertical Turbine pumps are available in sizes to produce from 40 to 16,000 gallons of water per minute. High efficiency saves hundreds of dollars on power cost per year.

AFFILIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. * Layne-Atlantic Co., Norfolk, Va. * Layne-Central Co., Memphis, Tenn. * Layne-Northern Co., Mishawaka, Ind. * Layne-Louisiana Co., Lake Charles, La. * Louisiana Well Co., Monroe, La. * Layne-New York Co., New York City * Layne-Northwest Co., Milwaukee, Wis. * Layne-Ohio Co., Columbus, Ohio * Layne-Texas Co., Houston, Texas * Layne-Western Co., Kansas City, Mo. * Layne-Western Co. of Minnesota, Minneapolis, Minn. * International Water Supply Ltd., London, Ontario, Canada * Layne-Hispano Americana, S. A., Mexico, D. F.

LAYNE

WELL WATER SYSTEMS VERTICAL TURBINE PUMPS

troleum supply, granted a subsidy for the development of the process, which has become known as the Fischer-Tropsch process. Additional work by several German companies indicated a necessity for larger quantities of cheap oxygen. The need for oxygen stimulated research, which finally resulted in the Linde-Frankl process, and in 1938, I. G. Farbenindustrie was producing 32,000,000 cu. ft. per day of 98 per cent pure oxygen.

Oxygen at a sufficiently low price, however, was still not available and attention was focused on a steam-methane process. The methane was supplied as a by-product of the Bergius process, which is a high pressure partial conversion of high grade peat to methane. The steam-methane reaction is a two-stage reaction to produce carbon monoxide and hydrogen, the latter mixture being reacted with additional steam where the carbon monoxide is converted to carbon dioxide, which is scrubbed out, and more hydrogen. The reaction has been used in America to supply cheap hydrogen and it was thought a modification of this method could be used to generate a mixture of carbon monoxide and hydrogen suitable for the synthesis of hydrocarbons. This method was not thought economical, however, due to the large quantity of heat that must be supplied at high temperatures.

Continued research for a more efficient means of converting methane into carbon monoxide and hydrogen led to an investigation of the direct reaction of methane and oxygen. The reaction is described by the following equation:

$$CH_4 + \tfrac{1}{2}O_2 \xrightarrow{1700^\circ\ F.+} CO_2 + 2H_2 \quad (\text{at } 1700^\circ\ F.+)$$

It was realized that a commercial plant would require large quantities of cheap oxygen. Additional research has led to the assertion that 40,000,000 cu. ft. of oxygen could be produced for 4.8 cents per thousand.

The catalytic reduction of carbon monoxide to yield hydrocarbons has been known since 1902 when Sabatier formed methane over nickel and cobalt catalysts at a temperature of 400-600° F. In 1912, German investigators discovered that higher hydrocarbons were formed when carbon monoxide and hydrogen were reacted over a catalyst at 775°-850° F. at 100-150 atmospheres. In 1923, Franz Fischer and Hans Tropsch discovered the hydrocarbon yield could be greatly increased by decreasing the pressure. Under German subsidy, hundreds of catalysts were examined, which led to the investigation in the United States of fluid or powdered catalysts.

The Hydrocarbon Research Company constructed a pilot plant in Olean, New York, in order that additional work could be done in investigating the possibilities of manufacturing gasoline from dry natural gas. Preliminary catalysts evaluation work done by the company indicates that all iron catalysts of the synthetic-ammonia type were active catalysts for the reaction of hydrogen and carbon monoxide. It has been estimated that a suitable iron catalyst could be manufactured for 5 cents per lb.

As mentioned, the Brownsville plant will produce lighter hydrocarbons, carbon dioxide, gasoline, diesel oil, and a mixture of alcohols and other oxygenated products. All products leave the reactor in a gaseous mixture, which is separated into fractions by cooling. The first separation divides the products into three cuts:

1. Oil—gasoline, diesel oil, and some oxygenated compounds.
2. Gas—lighter hydrocarbons, carbon monoxide and dioxide, hydrogen, and nitrogen.
3. Water—the balance of oxygenated compounds and water.

The isolation and treating of the desired products is highly involved. The Brownsville plant will cost approximately $14,000,000, and the gas requirements will be supplied from large gas reserves in the Valley that, heretofore, have had very little market outlet.

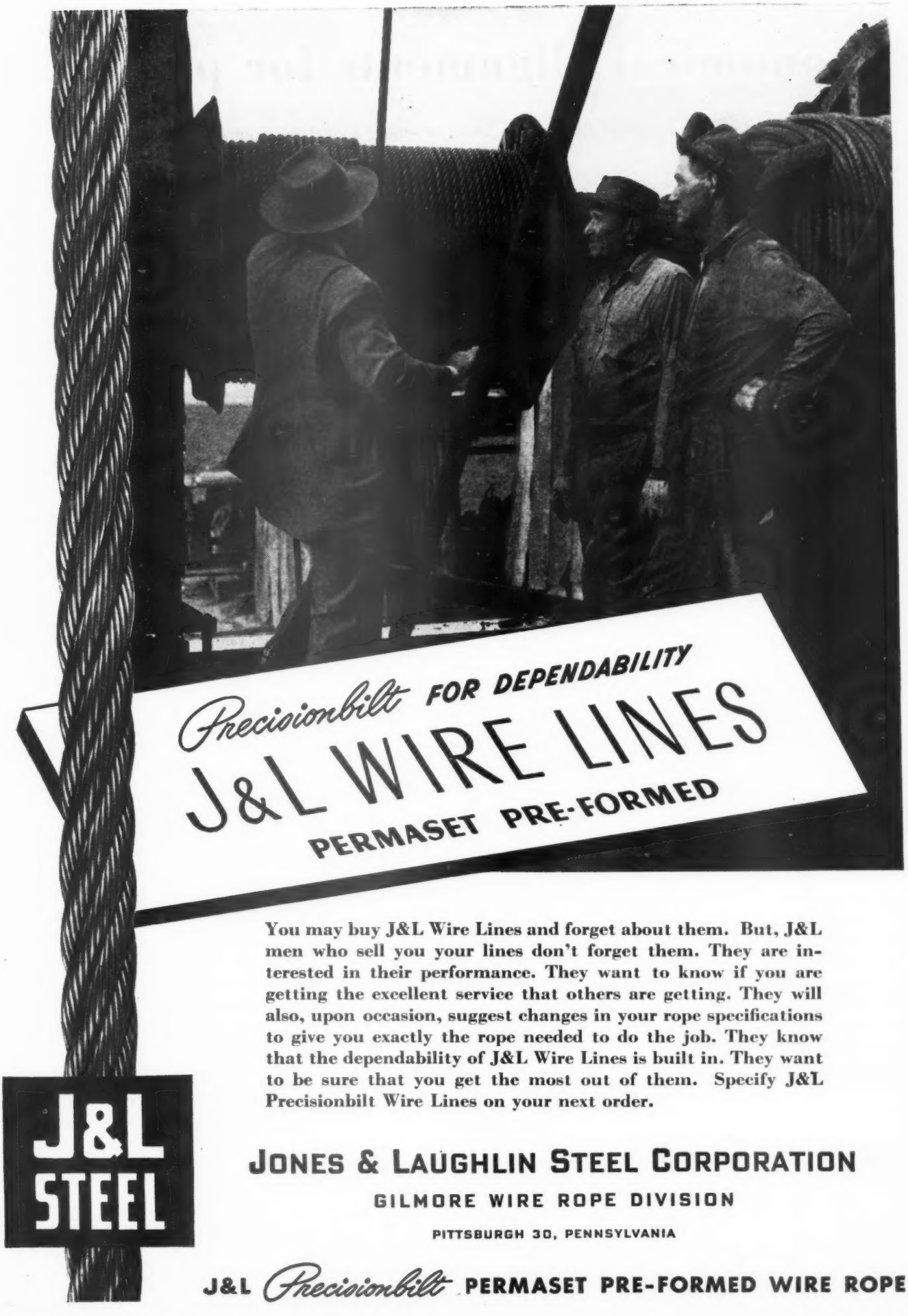
The Celanese plant at Bishop, Nueces County, was begun in 1944 and additional construction is still in progress. The process includes the controlled oxidation of gaseous petroleum hydrocarbons for the manufacture of acetic acid, acetic anhydride, methanol, propionec acid, and formaldehyde. Basic raw materials for the plant are propane and butane, which are obtained from gas cycling plants in the area. Plastics, textiles, and chemicals ultimately produced appear as wearing apparel, draperies, automobile accessories, kitchen, bathroom, and living room fixtures, and other items.

Perhaps one of the most interesting products is known as lindol, an organic phosphate, used principally at this time as an additive lubricant for aviation motors. Its properties—non-inflammable, high film strength, pressure and heat resistant—are such that it may be attractive as a lubricant in machinery were elevated temperatures and pressures exist. Other products such as lumarith, vimlite, and lumapane, all non-shattering glazings, are expected to find many uses as containers, insulators, water-proofing agents, and materials for construction. Fortisan, a strong but light yarn, was used in the war for parachutes, shroud lines and sewing thread, and its peacetime production will be utilized in the manufacture of many products, ranging from wearing apparel to high pressure hose.

Methyl ethyl ketone, heretofore generally recovered as a by-product from fermentation processes, will also be made at the Bishop plant. The product is used in the production of plastics, rayons, lacquers, and varnishes.

The development of a process to make propionec acid from natural gas and the reaction of the acid with cellulose has led to the development of a new thermoplastic called Forticel. Ease of molding, high surface lustre without polishing, high impact strength, ease of colorability and low specific gravity, are properties indicating the possibility of its widespread use in many postwar fields.

★ ★ ★



You may buy J&L Wire Lines and forget about them. But, J&L men who sell you your lines don't forget them. They are interested in their performance. They want to know if you are getting the excellent service that others are getting. They will also, upon occasion, suggest changes in your rope specifications to give you exactly the rope needed to do the job. They know that the dependability of J&L Wire Lines is built in. They want to be sure that you get the most out of them. Specify J&L Precisionbilt Wire Lines on your next order.

J&L STEEL

JONES & LAUGHLIN STEEL CORPORATION

GILMORE WIRE ROPE DIVISION

PITTSBURGH 30, PENNSYLVANIA

J&L *Precisionbilt* PERMASET PRE-FORMED WIRE ROPE

Economical alignments for pipe lines

By **PEYTON BRYAN**, Assistant Division Engineer, Humble Pipe Line Company

WHENEVER pipe-line connections are to be made between three points, as illustrated in Fig. 1, there will usually be a wastage of from 5 to 9 per cent of the investment through a thoughtless choice of alignment. For some reason, there has existed among pipe-line engineers a blind devotion to the air-line route between the two most distant points, with a perpendicular branch to the third (alignments "A-B," and "C-D" of Fig. 1) although an elementary mathematical analysis will demonstrate its extravagance. An alternative sometimes adopted is the continuous line ("A - C - B" of Fig. 1), which, as will be developed, varies in relative length from the most economical to the most wasteful, depending on the position of "C."

EXCLUSIVE

This variation is illustrated in the three triangles of Fig. 1, wherein "A" represents the present terminus of a pipe line that is to be extended to points "B" and "C." In any of the three triangles there will be an alignment "A - E - B" and "C - E" such that the total length of the various branches will be a minimum. Letting x represent the distance of the junction from "D" along the perpendicular "C - D"; a the distance "A - D"; b the distance "D - B"; e the distance "C - D," and Q the total amount of pipe in the branches, then:

$$Q = (e - x) + a^2 + x^2 + b^2 + x^2$$

For a minimum value of Q, its first derivative with respect to x is set equal to zero, and solved for x.

$$x = \frac{\sqrt{(a^2 + x^2)\,(b^2 + x^2)}}{\sqrt{a^2 + x^2} + \sqrt{b^2 + x^2}} \quad \text{. . . . . equation (1).}$$

The equation is readily solved by trial. The degree of precision justifiable in the solution is dependent on the precision of the data and the unit cost of the pipe in place. For field connections, and where the distances have been scaled from small-scale maps, a slide rule gives results sufficiently approximate, whereas for "big-inch," or where laying costs are excessive and the points are accurately located, a more precise and laborious solution is justified.

Substituting the distances of the second triangle of Fig. 1 in equation (1):

$$x = \frac{\sqrt{(225 + x^2)\,(25 + x^2)}}{\sqrt{225 + x^2} + \sqrt{25 + x^2}}$$

Try $x = 6$

$$x = 6 = \frac{126.177}{23.966}$$

The value of the function is too small for the assumed value of x. Decreasing the value of x increases the value of the function. Try $x = 4$.

$$x = 4 = \frac{99.403}{21.927}$$

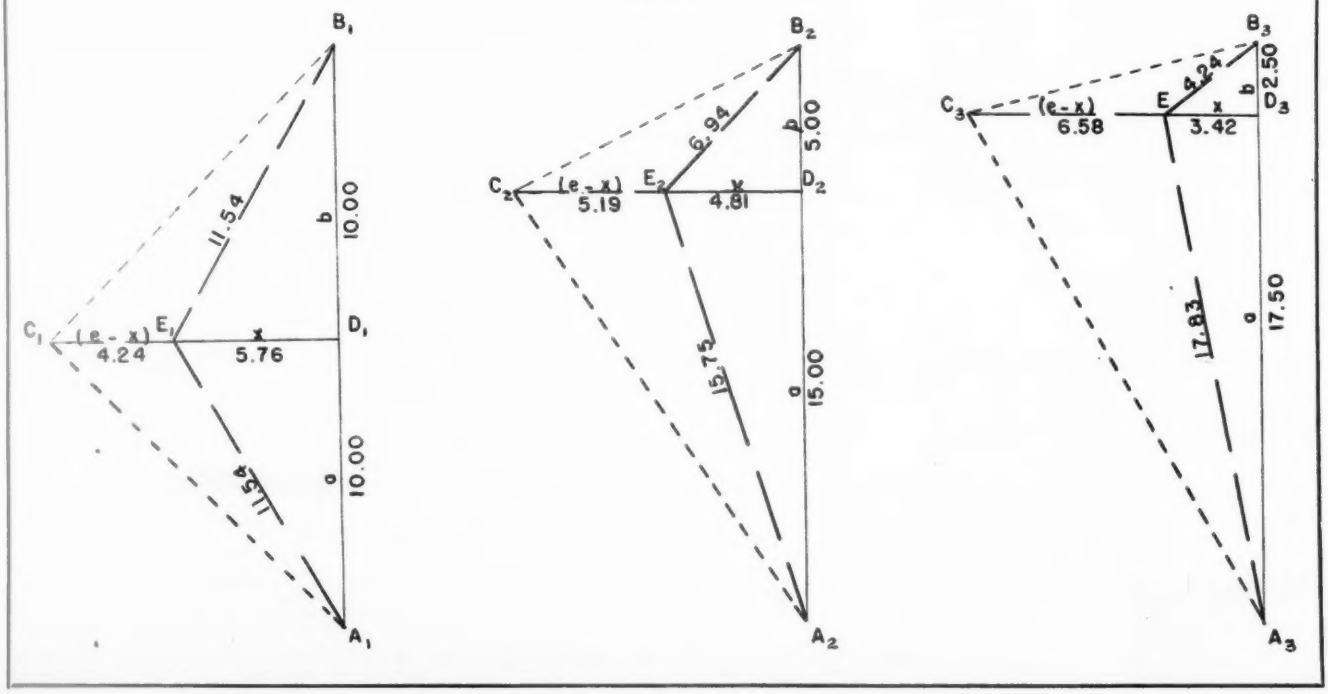
The function is now too large for the assumed value of x. Remembering that the value of the function varies (relatively) inversely as the value of x, a few more trials gives 4.81 as a good value for x. The total length of pipe required is:

$Q = (10 - 4.81) + 15.75 + 6.94 = 27.88.$

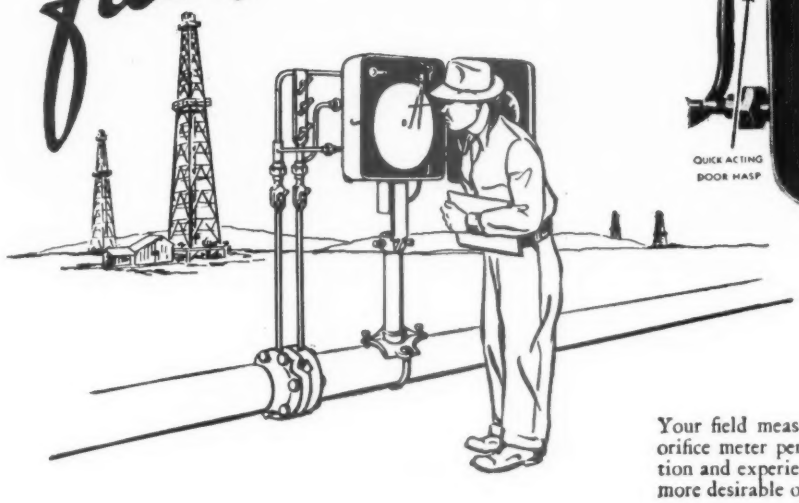
THE AUTHOR

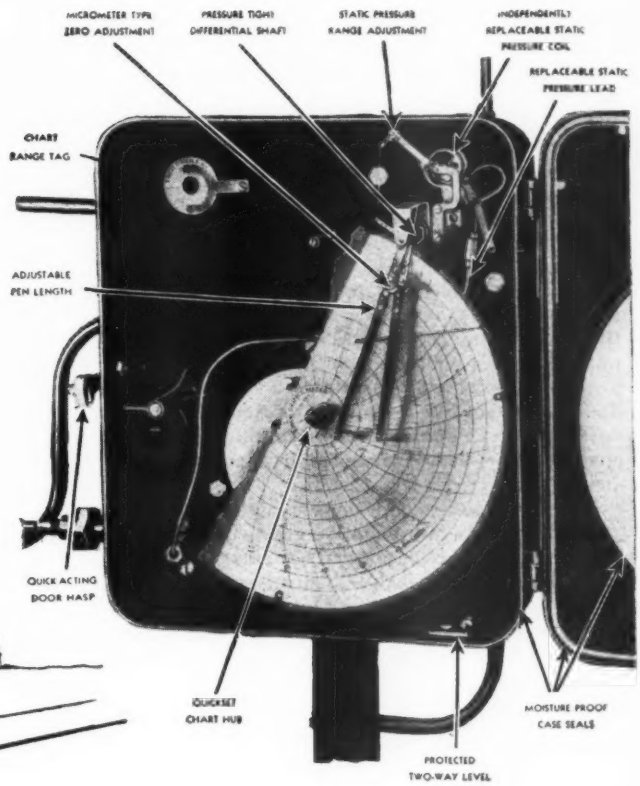
Peyton Bryan, a native Texan, has been with the engineering department of the Humble Pipe Line Company since 1933. His present position is assistant division engineer of Southwest Texas Division. He has been stationed at McCamey, Longview, Houston, and for the last 10 years at Corpus Christi. After studying at Texas Christian University Bryan spent 7 years on construction jobs in the Northwest and on steamships. He is a registered engineer in Texas.

FIG. 1



ASK YOUR OWN *field men*





Your field measurement men are in the best position to judge orifice meter performance and value. From front line observation and experience they will tell you that the Emco Gauge has more desirable operating features than any other design.

About THESE FEATURES

SIMPLIFIED ARRANGEMENT OF PARTS—Permit on-the-job operations to be accomplished with ease.

"QUICK-SET" CHART HUB—No loose parts. No threads. Cannot become lost or misplaced.

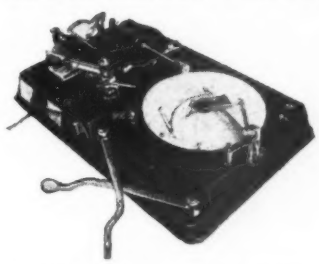
CHART RANGE TAG—Tells at a glance the static and differential range of the meter and the chart to be used for it.

POSITIVE INKING—Chart moves from under side of pen to top side. Eliminates blurred or missing records.

STURDY, OVERSIZE WORKING PARTS—Hold field service to a minimum.

SERVICE CONVENIENCE—The entire meter can be quickly disassembled or built up using common, every day tools.

IMPROVE ACCURACY, SAVE ON CHART COMPUTATION COSTS WITH THE EMCO-McGAUGHY INTEGRATOR



Mechanically and exactly calculates the extension of orifice meter charts. Assures that the accurate record made by the orifice gauge will be converted into accurate totals. Provides verified records of results.

One machine will calculate up to 300 average charts per day.

PITTSBURGH EQUITABLE METER DIVISION

Rockwell Manufacturing Co.

PITTSBURGH 8, PA.

instrument accurate

EMCO ORIFICE METERS

Had the lines been laid, the usual case, on "A - B" and "C - D" the length of pipe required would have been 30. Assuming the pipe to be 6 in., at $8000 per mile, equation (1) would produce a saving of 2.12 miles, or $16,960.

The solution of equation (1) for the other two triangles gives the results shown in Fig. 1. It is interesting to note that had "A," "B," and "E" been the points to be connected in any of the triangles, then the continuous line "A - E - B" would be the least possible length of pipe to connect the three points. In other words, if the value of x found by a solution of equation (1) is equal to, or greater than, the value of e, then the continuous line is the most economical arrangement.

It has been assumed, in deriving equation (1), that the minimum lengths will be obtained by laying from "C" along the perpendicular to "A - B." This is not always precisely true, for there are positions of the three points in which the absolute minimum would be obtained by laying along the bisectors of the three angles. If these distances are calculated for Fig. 1 it will be found that in the first triangle there is a difference in lengths of about 0.6 per cent in favor of equation (1); in the second triangle, the values are nearly identical; in the third triangle, there is a difference in favor of the bisectors amounting to about 0.7 per cent.

It has also been assumed that all branches are of equal diameter and unit costs. Very often the difference in delivery schedules from the two points will require a larger diameter pipe from "B" to "A" than for the branch "C - E." If M represents the unit cost of the line "A - E - B," and N represents the unit cost of the branch "C - E," then:

$$x = \frac{\sqrt{(a^2+x^2)\ (b^2+x^2)}}{M/N(\sqrt{a^2+x^2}+\sqrt{b^2+x^2})}$$

. . . . . equation (2)

For instance, if 6-in. pipe at $8000 per mile is required for "A - E - B," and 4-in. at $4800 per mile can be used for "C - E," then, in the second triangle of Fig. 1:

$$x = \frac{\sqrt{(225+x^2)\ (25+x^2)}}{8.0/4.8\,(\sqrt{225+x^2}+\sqrt{25+x^2})}$$

The value of x for this case is 2.89, giving 7.11 miles of 4 in. from "C" to "E," and 21.05 miles of 6 in. for the line "A - E - B." The investment for the alignment of equation (2) would be $202,528 as against $208,000 for the usual direct line from "A" to "B" with a perpendicular branch to "C."

A third case will often arise, in which the branches "B - E" and "C - E" can be of the same diameter, with a larger pipe required for their common outlet, "E - A." Letting M represent the unit cost of the "B - E" and "C - E" branches, and N the unit cost of the "E - A" line:

$$x = \frac{(a^2+x^2)\ (b^2+x^2)}{\sqrt{a^2+x^2}+N/M\sqrt{b^2+x^2}}$$

. . . . . equation (3).

Assuming 4 in. for the two branches, and 6 in. for "E - A" in the second triangle of Fig. 1, at the same estimated unit costs as before:

$$x = \frac{\sqrt{(225+x^2)\ (25+x^2)}}{\sqrt{225+x^2}+8.0/4.8\sqrt{25+x^2}}$$

The value of x is found to be 3.73, giving 6.27 miles of 4 in. from "C" to "E," 6.23 miles of 4 in. from "B" to "E," and 15.45 miles of 6 in. from "E" to "A." The use of equation (3) saves $4400 compared with the usual perpendicular connection.

It will sometimes be necessary to extend the pipe line toward "B" and "C" upon some given and arbitrary tangent, say the line "A - T" of Fig. 2, which for some reason (perhaps in order to parallel a railroad or highway) must be followed. It is desired to find the most economical point for the junction. By the same process as for the derivation of equation (1), it is found that this location "E" is given by:

$$\frac{x-i}{\sqrt{h^2+(x-i)^2}}+\frac{x+g}{\sqrt{f^2+(x+g)^2}}=1 \ldots \text{equation (4)}$$

In using this equation, the required tangent is produced beyond the points to be connected, and the perpendicular distances f and h are scaled or calculated. A line "C - B" is drawn between the two points and the distances i and g from this line to the feet of the perpendiculars are also scaled or calculated. With these four distances, equation (4) is solved by trial for the most economical location of the junction "E." It will be noted that in this equation the behavior of the function with respect to x is contrary to that of the previous equations, i.e., the relative value of the function increases with an increase in the value of x, and decreases with a decrease in the value of x.

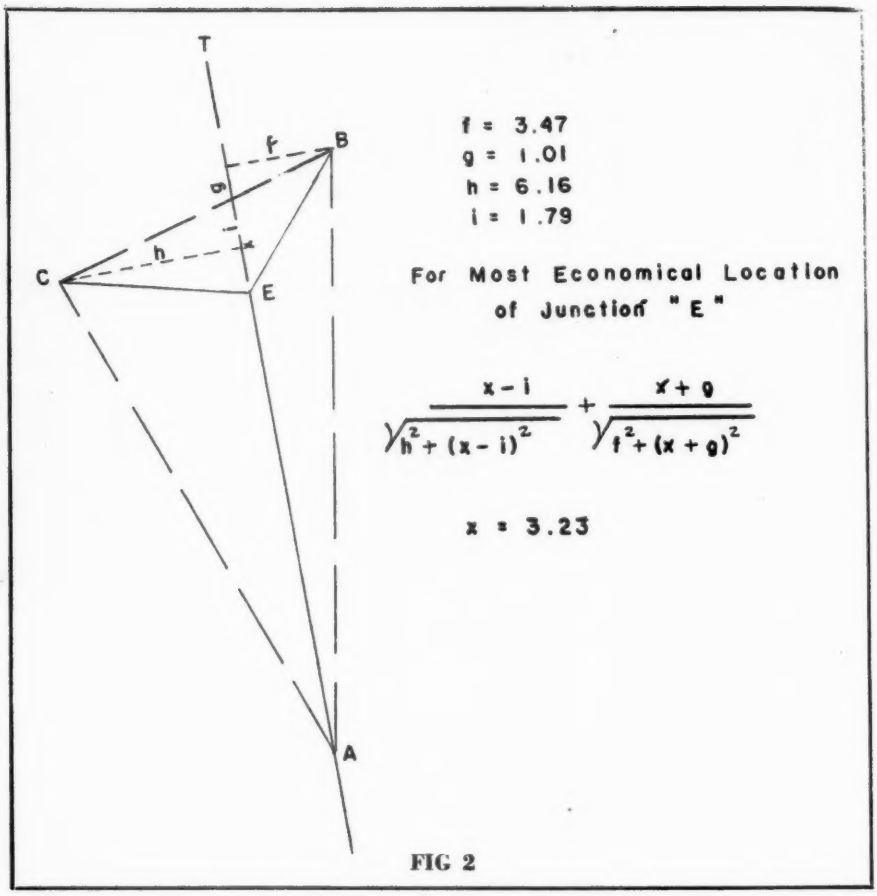


FIG 2

If the diameter of the branches "C - E" and "B - E" is different from that of the line "E - A," equation (4) is changed to:

$$\frac{M}{N}=\frac{x-i}{\sqrt{h^2+(x-i)^2}}+\frac{x+g}{\sqrt{f^2+(x+g)^2}}$$

. . . . . equation (5)

wherein M represents the unit cost of the line "E - A," and N represents the unit cost of the branches "C - E" and "B - E."

Unfortunately for the purely mathematical analysis, pipe lines are not laid upon paper, and unfavorable terrain, the obduracy of land owners, or considerations of future development may often modify the theoretical alignments of this discussion. The chances of their falling afoul any of those hazards, however, are certainly no greater than for the sanctified perpendiculars so neatly, so often, and so extravagantly laid down upon maps. Even when these equations can not be followed literally, they will be found useful as criteria in selecting the most economical arrangement of piping.

★★★

Built upon more than 25 years of specialization, and backed by an impressive array of truly remarkable performance records, Gaso leadership in its field is worldwide and unchallenged.

GASO PUMP & BURNER MFG. CO.
902 East First St., Tulsa, Okla.
Export Office: 149 Broadway, New York

Shreveport
W. L. SOMNER CO., 419 Lake Street

Los Angeles
PRODUCTION EQUIPMENT CO., Inc.
651 E. Gage Ave.

Electrical methods in oil exploration

By **V. G. GABRIEL,** *Consulting Geophysicist*

NOBODY would dispute a statement that the purpose of exploration for oil (electrical prospecting included) is the discovery of oil. The plan of attack, selection and use of the best techniques to accomplish this, however, are influenced by numerous considerations. Geologically, oil pools have been found at depths ranging from less than 100 ft. (Camarillo, W. Los Angeles oil fields in California, and Bradford field in Pennsylvania, for example) to more than 15,000 ft., and unquestionably progressive improvement in American drilling equipment and technique will lead to the discoveries of deeper and deeper oil reserves. Occurrences of petroleum underground are associated with various types of rocks and structures, also with changes in porosity, degree of cementation and mineralization met in the formations that comprise the upper crust of the earth. These changes in porosity and cementation (so-called petro-graphic and stratigraphic traps) have been responsibile throughout the ages for trapping large reserves of petroleum.

EXCLUSIVE

It is well-recognized that in certain areas, deep-seated structures are reflected in the overlying formations, through the existence of structures somewhat similar to those found at much deeper horizons; moreover, oil accumulations can be detected by the observation of perceptible (Megascopic) oil seeps and gas leakages at the surface. Modern geological and geophysical exploratory methods show that minute (microscopic) quantities of gaseous and liquid hydrocarbons found in the soil may serve under favorable conditions (lithological and stratigraphic), as a reliable guide for the detection of oil reserves hidden underground. The presence of mineralized zones at relatively shallow depths, and a careful analysis of near-surface waters, also may yield valuable information, and a heavy penalty, figuratively speaking, is usually paid for the failure to recognize the value of such information. The Tomball oil field in the Gulf Coast area, whose discovery is credited to the Torsion Balance, was clearly delineated by H. E. Minor in 1924, through the use of analysis of near-surface waters for salinity. In many areas, the presence of certain rocks, such as salt domes in the Gulf Coast area or volcanic plugs in northeastern Louisiana, is a reliable guide in exploration for oil.

An oil geologist usually employs, during the process of correlation and identification of the formations that comprise the earth crust, a great variety of powerful tools not related to each other. Stratigraphy, petrology, petrography, paleontology, micro-paleontology, paleoichthyology (fish scale correlation), geophysical coring methods, etc., are at his service.

In electrical exploration, however, electrical properties of the formations, as recorded by an electrical method under consideration, must stand alone and reveal or fail to reveal pertinent data.

Rocks and minerals, which comprise the earth's crust, can be identified to some extent by their electrical properties, such as resistivity (conductivity), dielectric constant, and magnetic permeability. Numerous data, both laboratory and field, pertaining to electrical properties of rocks, have shown that small variations in lithology, in the degree of cementation and porosity, in the amount and type of water held, temperature variations, as well as various stratigraphic considerations, etc., play an important part in the magnitudes of electrical characteristics. For convenience of discussion, let us subdivide the variety of factors influencing the electrical properties of rocks located underground into the following groups: (1) Lithological factors; (2) stratigraphic and structural factors; (3) the degree of cementation and mineralization; (4) porosity; (5) water content, and (6) temperature.

Lithological factors, here assumed, comprise the composition of rocks, their age and classification, the degree of crystallization (for igneous rocks), the size and form of the grains (for sedimentary rocks), etc. According to Jakosky, the resistivities of sedimentary rocks expressed in ohms-centimeter range as follows: Glacial sediments from 8×10^{-2} to 9.5×10^{5}, sands from $9.5 \times 10^{+1}$ to 5×10^{5}, soils from 2×10^{2} to 1×10^{6}, shales from 8×10^{2} to 1×10^{6}, sandstones from 3×10^{3} to 1×10^{7}, conglomerates from 2.5×10^{3} to 1.5×10^{6}, and limestones 6×10^{3} to 5×10^{7}.

According to Guyod, the effective resistivities, expressed in ohms-centimeter, and measured with alternating currents at 60 cycles per second range from 2×10^{2} to 3×10^{3}, for the formations that comprise young structures, and from 1×10^{5} to 1.4×10^{6} for those of the oldest structures. Card states: "There is a more or less consistent relation between the low-frequency effective resistivity and the age and physical characteristics of the geological formations at any given point. . . . With certain exceptions increasing effective resistivity corresponds to increasing age, but this relation is very irregular. The range in resistivities, in general, is from 2 to 30 meter-ohms for very young structures to 1,000 to 14,000 meter-ohms for the oldest structures."

Dielectric constants, as observed, range from 8.0 electrostatic units to 12.0 electrostatic units for limestones, 9.0 electrostatic units to 11.0 electrostatic units for sandstones, and 2.0 + electrostatic units for sands.

Examination of the overall data shows that in exploration with alternating currents of relatively low frequencies dielectric constant, except under certain sets of lithological and stratigraphic conditions, is of little value in electrical exploration. Wide variations in the resistivities of rocks that are lithologically classified as one type, as well as broad and relatively small differences in resistivity observed among the extreme values exhibited by rocks of lithologically various types, render the work of interpretation of resistivity field data a difficult procedure; however, the well-observed fact that many localities are characterized by certain limited ranges in resistivities for a particular type of rocks greatly enhances and simplifies the technique of electrical interpretation.

Stratigraphic and structural factors are responsible for numerous variations in electrical constants as observed in many lithologically homogenous formations. Tension joints associated with anticlines, certain compression of material located in synclines as a result of compressive forces operating in the synclines during crustal readjustments, drag-folding, fault breccia, and gouge, all of these factors influence to some extent the observed magnitudes of electrical resistivity. Numerous investigators also show that the magnitude of observed resistivity often depends on the direction, that is, parallel or perpendicular to the strike, of electric current in a formation. Schlumberger and Leonardon state: "The coefficients of anisotropy, commonly encountered, vary from 1.0 to 2.5. The figures near unity are given by unconsolidated rocks (sands in particular) or rocks made up of slightly differentiated elementary layers. Compact rocks or rocks that show either a good fissility or quite large variations in conductivity between their elementary layers (Schist for instance) give, on the other hand, fairly high figures." Koenigsberger, in his investigation pertaining to sedimentary formations found in southern Germany, gives the following data: The resistivity of Dark Jurassic shales in the direction parallel to schistosity was found to be 5×10^{4} ohms-centimeter, whereas the resistivity of the same shales in the direction perpendicular to schistosity was determined as equal to 1.2×10^{7} ohms-centimeter. It is of interest to note that according to International Critical Tables, the resistivities of a quartz crystal at 20° C. are

Playing in the Rough!

USE OSHKOSH

Oshkosh 6-Wheel-Drive Truck moving a skid-mounted mud pump in soft dirt territory

OSHKOSH STAR FEATURES

- ★ All Wheel Drive
- ★ Hydraulic Power Steer
- ★ Maximum Maneuverability
- ★ Rugged Transmissions
- ★ Sturdy Frame and Axles
- ★ Powerful Engine
- ★ Hydraulic Coupling
- ★ Heavy Duty Over Size Industrial Radiator

Oil field jobs are of necessity mostly "in the rough"—heavy hauling thru sand, soft dirt or sticky mud to and from the toughest locations. The reason Oshkosh trucks are noted for their outstanding performance under such conditions is primarily due to the simple but sturdy construction of Oshkosh 4 and 6 wheel drive mechanism. Positive, locking center differential regulates the distribution of engine power to the front and rear axles, thereby automatically applying the power to the best tractive advantage. In addition, Oshkosh provides easy steering due to the free, smooth power distribution through the axles and the shock-proof steering mechanism. Write us your needs and we will tell you what model is best suited.

OSHKOSH MOTOR TRUCK, INC.
OSHKOSH, WISCONSIN

1.0×10^{14} ohms-centimeter and 2.0×10^{16} ohms-centimeter with the directions of field resectively parallel and perpendicular to the optical axes of the crystal.

The process of cementation and mineralization usually means both the decrease in the degree of porosity exhibited by an original formation and the introduction of new minerals and material whose electrical properties may be different from those of the basic formation. Rosaire and others found distinct changes in electrical properties (resistivity and transient phenomena) in the mineralized areas.

All rocks are in some degree porous, with their volume porosities ranging from 1 per cent and less in igneous rocks, such as granite for example, to 50 per cent in loams containing a good deal of clay. In addition to porosity, rocks may be geologically characterized by the presence of open joints, cavities, fissures, bedding planes, etc. This size of pore spaces, the degree of porosity, the presence or absence of fissures, bedding planes, etc., all of these factors have marked influence on the magnitudes of electrical resistivity as exhibited by the rocks. Barfield, in using artificial oil sand saturated with sodium chloride solution of water, has obtained the following results: 3.5×10^2 ohms-centimeters for 90 per cent saturation and 45 per cent porosity, 1×10^2 ohms-centimeter for 90 per cent oil saturation and 20 per cent porosity, 9.0 ohms-centimeter for 60 per cent oil saturation and 45 per cent porosity, 5.0 ohms-centimeter for 60 per cent oil saturation and 20 per cent porosity.

Water is widely distributed through the formations that comprise the upper layers of the earth crust. The amount of water found in a formation depends on numerous factors, such as the degree of porosity, depth of occurrence, age, the initial conditions during the time of deposition, etc. Water disseminated through the rocks is usually subdivided, according to its origin, into the following types: (1) Magmatic, water induced during the process of cooling and solidification of magma; (2) connate, water which is indigenous to the rocks containing it, and (3) meteoric, water representing that part of rain water, including melting snow, that has soaked into the rocks.

Electrically, waters held in rocks exhibit a wide range of resistivity, magnitudes depending on the amount and type of dissolved salts. According to Guyod, the resistivities of fresh water range from 1×10^3 to 2×10^4 ohms-centimeter, whereas the resistivity of connate water is 1×10^1 to 8×10^1 ohms-centimeter. Sundberg gives the following data expressed in ohms-centimeter: The resistivity of normal sandstones and limestones saturated with surface water is from 1×10^5 to 1×10^6; the resistivity of normal sandstones and limestones saturated with connate water is 5×10^2 to 1×10^3; the resistivities of clays and sands saturated with surface and connate waters range from 4×10^4 to 4×10^5 and 2×10^2 to 4×10^2 respectively.

A student of geology is familiar with the distribution of temperature in the earth crust. Assuming, for convenience of discussion, an average temperature gradient as equal 64 ft. per 1° F. and the surface temperature as equal 60° F., we can calculate that at the depth (let us say 6400 ft.) the temperature is 160° F. approximately. According to Guyod, the resistivity of any surface formation will be cut by more than one-half from the increase of temperature alone, if placed at the 6000-ft. depth. International Critical Tables give 10×10^{18} ohms-centimeter and 10×10^{15} ohms-centimer as the resistivities of vitreous silica for 20° C. and 200° C., respectively.

It is common practice in geophysical exploratory methods to overemphasize the geological aspects of exploration, and to carry into its final interpretation the methods and habits well-adopted for a purely geological investigation only. As stated elsewhere in this article, changes in porosity, in the degree of cementation and mineralization, relatively small variations in lithology, etc., may have a profound influence on the magnitudes of electrical resistivity as recorded in exploration. To interpret, as is usually done, any marked change in resistivity as an electrical record of an independent lithological and stratigraphic unit, is a disregard for the electrical properties of the earth's crust.

Electrical properties of the earth's crust, as was stated elsewhere in this article, are a sum total of numerous physical factors, and may or may not conform with lithological and stratigraphic units of the formations under consideration. Geometrically, these variations in electrical resistivities are usually reflected in both horizontal and vertical non-homogeneities.

Present day development in electrical exploration is under heavy obligation to Maxwell, an English physicist. Maxwell, in the middle of the 19th century, proposed a theory of electro-magnetic waves and outlined the methods for the solution of various electric problems. During the last two decades, various able investigators in the United States and abroad have applied and extended Maxwell's principles for the solution of various problems usually met in exploration. More than a decade ago, Stevenson stated: "The present paper attempts to give a general theory by showing how a formal solution of the problem of determining the potential when σ (conductivity) is assumed to be an arbitrary assigned continuous function of position, (and not necessarily a function of depth only), may be obtained by method of successive approximation. The converse problem of determining σ from a knowledge of surface potential is then shown to lead to an integral equation that possesses no unique solution. If, however, σ is assumed in advance to be a function of depth only, in which case the surface potential must, of course, be symmetrical with respect to the electrode. The last conclusion is also reached by Slichter and Langer . . . "A few years later Evjen stated: "Changes in resistivity along the surface of the ground . . . have a relatively large effect upon the measured results . . . A comprehensive three-dimensional analysis of electrical measurements is as yet beyond the realm of practical possibilities. The assumption that the electric properties of the ground are horizontally stratified therefore appears to be necessary for dependable depth calculations."

Despite a visual disagreement between the actual and assumed electrical pictures of the earth's crust, electrical exploration has achieved a good measure of success.

For convenience of discussion, let us subdivide electrical exploratory field methods into the following groups: (1) Direct detection of oil; (2) the detection of favorable oil structures and conditions, such as petrographic traps, etc.; (3) the detection of certain favorable phenomena, such as gas and oil leaks, surface mineralization, etc., that may or may not be associated with the occurrence of oil, and (4) the study of general geology.

Direct detection of oil with the use of electrical methods has been tried and experimented with on a large scale during the last two decades. Potapenko (polarization method), W. Lewis and Evjen (Elflex method), Evjen (Variation of Path method), T. West and Beacham (Resistolog method), and others have reported on the possibility of successful application of their respective techniques in direct detection of oil accumulations, and effective (at least with some of the methods) to maximum depths of 6000 ft. The possibility of this detection is based on the existence of perceptible resistivity differences between oil sands and those of overlaying formations and, to some extent, on the inference from and the comparison with the data obtained with other field surveys, especially with those in adjacent areas.

According to Guyod, the resistivity of crude oil is equal to 1×10^6 ohms-centimeter. Schlumberger and Leonardon give 9×10^3 to 1.1×10^4 ohms-centimeter and 2.2×10^4 ohms-centimeter as the resistivities of oil sands located in the Seminole field, Oklahoma, and Grozny oil district, Russia, respectively; whereas Duessen and Leonardon give 4×10^2 to 1.8×10^3 ohms-centimeter as the resistivity of oil sands located near Hull, Texas. It is of interest to note that Lewis and Horner state: "The pores of many oil pools . . . are filled 10 to 50 per cent of their volumes with electrolitic solutions . . . the presence of interstitial water in an oil-bearing formation introduces the proposition that a definite oil-water contact does not exist in most reservoirs . . . absolute resistivity values for oil sands in situ should therefore be lower than values for dry or artificially oil-saturated sands."

Electrical field correlation and identification of certain key horizons are based at least theoretically on the uniqueness and some consistency (both lateral and vertical) in electrical magnitudes of these markers, and these conditions are seldom met in exploration. Nevertheless,

You save time and work when you thread pipe with this RIDGID No. 65R

Tighten on pipe with 1 screw

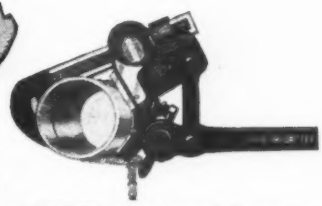
It stands up handily on its own feet.

● Threading 1" to 2" pipe is no chore at all with the self-contained quickly adjusted No. 65R threader. Its high-speed steel chasers set to size in 10 seconds — no loose dies to bother with or lose. Workholder sets to pipe size instantly — no bushings, only one screw to tighten on pipe. And you cut smooth perfect threads with the least possible effort. See for yourself why it's so popular — ask for this time and work-saver No. 65R threader at your Supply House.

Only RIDGID guarantees you a repair-free housing . . .

UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free
THE RIDGE TOOL CO.
ELYRIA, O.

SIZES 6" TO 60"



RIDGID *Compound Leverage Wrench.*

● You get more for your money with RIDGID pipe wrenches. That special design housing simply won't warp or break in any normal use, however strenuous — as millions of users know. No laid up for housing repairs, no bother and expense. No binding of adjusting nut — it spins easily to size. Alloy jaws take hold and let go instantly. Handy pipe scale on hookjaw, comfort-grip I-beam handle. A wrench it's a pleasure to work with — ask your Supply House.

Millions of RIDGID Tools in use

★ RIDGID ★

WORK-SAVER PIPE TOOLS

The Ridge Tool Company
Elyria, Ohio, U. S. A.

various resistivity and potential methods such as "Gish-Rooney," "Megger," "Continuous Profiling," "Elflex," "Resistolog," "Variation in Path," and others have been successfully applied in exploration for favorable oil structures and conditions, because in certain areas the electrical properties are less complex or more amenable to careful interpretation than is usually anticipated.

For structures and faults found at relatively shallow depths, various electromagnetic and radio frequency techniques may be of value.

For the detection of gas and oil leaks at the surface and other phenomena (such as mineralization, etc.) located at relatively shallow depths, radio-frequency techniques may be of value.

For the detection of gas and oil leaks at the surface and other phenomena (such as mineralization, etc.) located at relatively shallow depths, radio-frequency methods, electro-magnetic methods, and improved electric transient techniques may be of value.

● **Recapitulation and conclusions.** Occurrences of oil underground are associated with various structures, for example, anticlines, monoclines, salt domes, faults, etc., and conditions, such as changes in porosity, the degree of cementation and mineralization.

Oil accumulations may or may not be associated with megascopic (perceptible) or microscopic oil seeps and gas leakages.

Electrical variations in underground resistivities are three-dimensional in nature and may or may not conform with the lithological and stratigraphic units of the formations in the area under investigation.

Electrically, oil sands may or may not be characterized by relatively higher resistivities than those of the overlying formations.

Oil accumulations associated with changes in porosity and in the degree of cementation may or may not be reflected in perceptible changes in the magnitudes of electrical resistivity.

In areas where the rocks conform to certain electrical patterns, the presence of oil can be inferred with some measure of success.

The presence of perceptible electrical key-horizons in many areas under investigation renders electrical field methods a valuable tool in search for favorable oil structures.

It is probable that electro-magnetic and radio-frequency and improved electric transient techniques, which up to date have played a rather insignificant role in the oil industry, may be found to be of value in the investigations of relatively shallow depths, and in the detection of oil leaks and gas seepages at the surface.

In areas where natural earth currents do exist and where general information at a relatively shallow depth is desired, telluric methods may yield pertinent information.

Bibliography

Joseph L. Adler: "Geophysical Exploration for Stratigraphic Oil Traps," *Geophysics* VIII (4) October, 1943.

Barfield: "Some Measurements of Electrical Constant of the Ground," *J.I.E.E.*, August 1934.

A. Belluigi: "Seismic-Electric Effects," *Oil Weekly*, November 29, 1937, pp. 38-42.

Solomon Bilinsky: "On The Field Due To A Vertical Line Source . . ." *Geophysics* III(1) January, 1938.

E. E. Blondeau: "Shallow Resistivity Survey at South Elton, Louisiana," *Geophysics* IV(4) October, 1939.

M. C. Bowsky: "The Effect of Mud Resistivities on the Intensities of Electrical Logs," *Geophysics* VII (1), January, 1942.

R. H. Card: "Correlation of Earth Restitivity With Geological Structure and Age," *A.I.M.E. Transactions, Geophysical Prospecting*, 1940.

R. H. Card: "Correlation of Earth Resistivity With Geologic Structure and Age," *A.I.M.E. Technical Publication No. 829*, February, 1937.

Ernst Cloos: "Auto Radio—An Aid in Geologic Mapping," *American Journal of Science* 28(166) 255, 1934.

R. S. Dahlberg, Jr.: "An Investigation of Natural Earth Currents," *Geophysics* X(4) October, 1945.

D. Ehrenburg and R. Watson: "Mathematical Theory of El. Flow in Stratified Media," *A.I.M.E. Geophysical Prospecting*, 1932.

C. M. England: "A Resistivity Survey of the Monument Oil Field" *Geophysics* VIII (1) January, 1943.

A. S. Eve: "Absorption of Electromagnetic Induction and Radiation by Rocks," *A.I.M.E. Geophysical Prospecting*, 1932.

A. S. Eve and D. A. Keys: *Applied Geophysics* Cambridge University Press, 1929.

H. M. Evjen: "Depth Factors and Resolving Power of Electrical Measurements," *Geophysics* III(2) March, 1938.

H. M. Evjen: "Utility of the Electric Methods of Geophysical Exploration," *Geophysics* VIII(2) April, 1943.

H. M. Evjen: "The Principle of Variation in Path With an Application to Structural Mapping," *Geophysics* X(2) April, 1945.

V. G. Gabriel: "Present Status of Electrical Exploration," *"The Petroleum Engineer*, January, 1946.

V. G. Gabriel: "Electrical Resistivity Methods of Exploration," *Petroleum World*, Annual Review, 1944.

V. G. Gabriel: "Electric Transient Methods," *Petroleum World*, January, 1945.

B. Gutenberg: "Geophysics as a Science," *Geophysics* II(3) July, 1937, pp. 185-

Hubert Guyod: "Electrical Well Logging," *The Oil Weekly*, August 7, 14, 21, 28; September 4, 11, 18; October 2, 9, 16, 23, 30; November 13, 20, 27; December 4, 1944.

Hubert Guyod: "Electric Log Interpretation," *The Oil Weekly*, December 3, 10, 17, 24, 1945.

Paul F. Hawley: "Fault Location by Electrical Prospecting—An Example, *"Geophysics* VIII(4), October, 1943.

Paul F. Hawley: "Transients in Electrical Prospecting," *Geophysics* III(3) July, 1938.

Helmer Hedstrom: "Phase Measurements in Electrical Propecting," *A.I.M.E. Geophysical Prospecting*, 1940.

C. A. Heiland: *Geophysical Exploration*, Prentice-Hall, Inc., 1940.

Folke H. Hihlstedt: "Electrical Methods in Prospecting for Gold," *A.I.M.E. Geophysical Prospecting*, 1934.

W. O. Hotchkiss W. J. Rooney and James Fisher: "Earth Resistivity Measurement in The Lake Superior Copper Country," *A.I.M.E. Geophysical Prospecting*, 1929.

B. F. Howell, Jr.: "Some Effects of Geologic Structure on Radio Reception," *Geophysics* VIII(2) April, 1943.

M. King Hubbert: "Earth Resistivity Surveying in Illinois," *A.I.M.E. Transactions, Geophysical Prospecting*, 1934.

M. King Hubbert: "Results of Earth Resistivity Survey on Various Geologic Structures in Illinois," *A.I.M.E. Geophysical Prospecting*, 1934.

J. N. Hummel: "A Theoretical Study of Apparent Resistivity in Surface Potential Methods," *A.I.M.E. Geophysical Prospecting*, 1932.

International Critical Tables, National Research Council of the U.S.A. McGraw-Hill Book Co., Inc., New York.

J. J. Jakosky: "Exploration Geophysics," *Times-Mirror*, Los Angeles, 1940.

J. J. Jakosky: "Continuous Electrical Profiling," *Geophysics* III(2), March, 1938.

J. J. Jakosky and R. H. Hopper: "The Effect of Moisture on the Direct Current Resistivities of Oil Sands and Rocks," *Geophysics* II(1), January, 1937.

J. J. Jakosky, C. H. Wilson, and J. W. Daly: "Geophysical Examination of Meteor Crater, Arizona," *A.I.M.E. Geophysical Prospecting*, 1932.

J. J. Jakosky: "Operating Principles of Inductive Geophysical Processes," *A.I.M.E. Geophysical Prospecting*, 1929.

J. C. Karcher and Eugene McDermott: "Deep Electrical Prospecting" *A.A.P.G. Bull.* XIX(1), January, 1935.

L. V. King: "On the Flow of Electric Current in Semi-Infinite Stratified Media," *Proceedings Roy. Soc.* (139)237, 1933.

L. V. King: *Transactions Roy. Soc.* (233) 237, 1934.

Paul W. Klipsch: "Recent Development in Eltran Prospecting," *Geophysics* IV(4), October, 1939.

J. G. Koenigsberger: "Field Observations of Electrical Resistivity and Their Practical Application," *A.I.M.E. Geophysical Prospecting* 1929.

E. Lancaster-Jones: "The Earth Resistivity Method in Geophysical Prospecting," *Mining Magazine*, 355-60(42) and 43(19-28), 1930.

F. W. Lee: "Measuring the Variation of Ground Resistivity With a Megger," *U. S. Bureau Mines Tech. Paper No. 440*, 1928.

F. W. Lee, J. W. Joyce and P. Boyer: "Some Earth Resistivity Measurements," *U. S. Bureau Mines Inf. Circ. 6171*, 1929.

E. G. Leonardon and Sherwin F. Kelly: "Application of Structural Methods to Structural Studies," *A.I.M.E. Geophysical Prospecting*, 1929.

W. B. Lewis: "Working Depth for Low Frequency in Electrical Prospecting," *Geophysics* X(1), January, 1945.

Bela Low, Sh. F. Kelly, and W. B. Creagmile: "Applying the Megger Ground Tester in Electrical Exploration," *A.I.M.E. Geophysical Prospecting*, 1932.

Hans Lundberg and Th. Zuschlag: "A New Development in Electrical Prospecting," *A.I.M.E. Geophysical Prospecting*, 1932.

Hans Lundberg: "Recent Results in Electrical Prospecting for Ore," *A.I.M.E. Geophysical Prospecting*, 1929.

James B. Macelwane: "Fifteen Years of Geophysics. A Chapter in the Exploration of the United States and Canada," *Geophysics* V(3), July, 1940.

M. Martin, G. H. Murray and W. J. Gillingham: "Determination of the Potential Productivity of Oil-Bearing Formations by Resistivity Measurements," *Geophysics* III(3), July, 1938.

Morris Muskat: "Potential Distribution About Electrodes On the Surface of the Earth," *Physics* 4 129, 1933.

M. Muskat and H. H. Evinger: "Current Penetration in Direct Current Prospecting," *Geophysics* VI(4), October, 1941.

L. L. Nettleton: *Geophysical Exploration*, McGraw-Hill Book Company, Inc., New York, 1940.

C. L. Pekeris: "Direct Method of Interpretation in Resistivity Prospecting," *Geophysics* V(1), January, 1940.

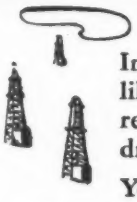
Leo J. Peters and John Bardeen: "Some As-

New process produces important chemical

A discovery just announced by two Chicago research chemists is of lively interest to oil refiners. First, it may greatly increase the value of propylene, a by-product of cracking; second, it may lead to the profitable operation once more of hydrogenation units that have been standing idle since the end of the war. The discovery is another link joining the oil and chemical industries together.

Discoverers are George L. Hervert and Carl B. Linn of Universal Oil Products Company. They have found that acetone, an important chemical, can be produced by catalytic conversion of isopropyl alcohol, using nickel as a catalyst. The same process also can produce methyl isobutyl ketone, known commercially as Hexone, and diisobutyl ketone, both of which products are of higher value than acetone.

STOP THAT THIEF IN YOUR WELL



In every well, severe pressures lurk like a sly thief—seeking weak casing—ready to crush it—ready to steal hundreds of hours of production.

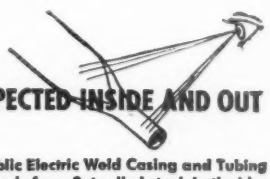
You can stop this thief by insisting that your strings be made up with Republic Electric Weld Casing.

Produced by Republic's improved welding process, the weld is as strong as the wall. Normalizing, cold forming and sizing give Republic Casing extra strength and ability to resist tremendous external pressures.

Because it is made from flat-rolled steel, Republic Casing is uniform in wall thickness, size, roundness and concentricity. These qualities assure accurate threads with added pull-out strength, because the maximum amount of steel is left under the thread roots at all points on the circumference.

Be sure you get every one of these money-saving advantages, by specifying Republic Electric Weld Tubing and Casing.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N. Y.



INSPECTED INSIDE AND OUT

Republic Electric Weld Casing and Tubing are made from flat-rolled steel, both sides of which can be inspected. Thus, the surface which becomes the inside wall is free from hidden defects.

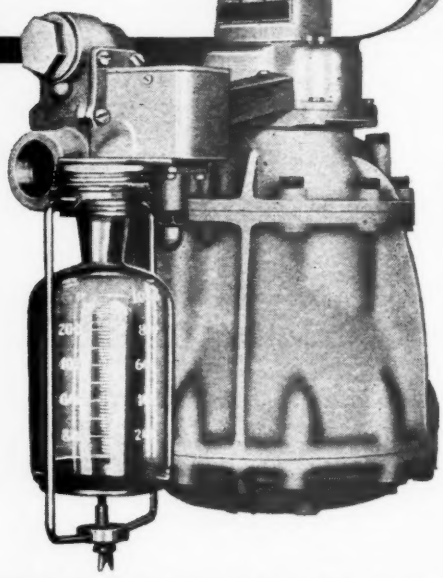
REPUBLIC
LINE PIPE
NORMALIZED CASING AND TUBING

Other Republic Products include Alloy Steels—U

BOWSER
ESTABLISHED 1885

WELL-CHECK SYSTEM

SAMPLES
and
METERS
CRUDE PRODUCTION
AT THE WELL
Automatically



INDIVIDUAL WELL PRODUCTION RECORDS MEAN . . .

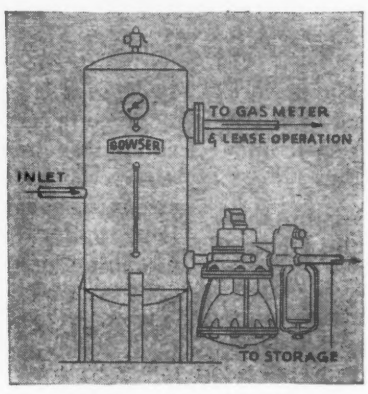
- Accurate and indisputable basis for royalty and tax payments.
- Elimination of gauge tanks, piping and handling.
- G/O ratios for conservation and reservoir study.
- Prevention of evaporation losses due to weathering.
- Quick detection of sleepers or wet wells.
- Lower transportation costs by utilization of well energy.
- Reduced fire and other hazards.
- True proportionate samples of each well's production.

QUALITY

with true proportionate sample provided by Bowser Automatic Oil Well Sampler.

QUANTITY

with Bowser Special Oil Field Meter. Dependable operation—no metal-to-metal contact.



LOOK FOR BOWSER

Write today for the new Bowser booklet of equipment for modern oil fields.
Bowser, Inc., 1329 Creighton Avenue,
Fort Wayne 2, Indiana

LIQUID CONTROL SPECIALISTS SINCE 1885

pects of Electrical Prospecting Applied In Locating Oil Structures," *Physics* II(3), March, 1932.

Sylvain J. Pirson: "Interpretation of Three-layer Resistivity Curves," *A.I.M.E. Geophysical Prospecting*, 1934 .

G. V. Potapenko: "Method of Determining the Presence of Oil," U. S. Pat No. 2,190,320, of February 13, 1940; also U. S. Pat. Nos. 2,190,321 and 2,190,322, of same date.

Irwin Roman: "How to Compute Tables for Determining Electrical Resistivity," *U. S. Bureau Mines Technical Paper No. 502*, 1931.

E. E. Rosaire: "Shallow Stratigraphic Variations over Gulf Coast Structures," *Geophysics* III(2), March, 1938.

I. E. Rosenzweig: "A New Method of Depth Determination in Earth-Resistivity Measurements," *A.I.M.E. Geophysical Prospecting*, 1940.

I. E. Rosenzweig: "New Theory of Apparent Resistivity of Horizontally Stratified Soils," *A.I.M.E. Geophysical Prospecting*, 1940.

W. M. Rust: "Typical Electrical Prospecting Methods," *Geophysics* V(3), July, 1940.

W. M. Rust: "Historical Review of Electrical Prospecting Methods," *Geophysics* III(1), January, 1938.

Richard Sneddon: "New Science Identifies Sub-surface Strata From Fossil Fish Scales," *The Petroleum Engineer*, XVII(1), October, 1945, pp. 274-278.

C. & M. Schlumberger and E. G. Leonardon: "Electrical Coring," *A.I.M.E. Geophysical Prospecting*, 1934.

C. & M. Schlumberger and E. G. Leonardon: "Some Observation Concerning Electrical Measurements in Anistropic Media and Their Interpretation," *A.I.M.E. Geophysical Prospecting*, 1934.

Conrad and Marcel Schlumberger: "Depth of Investigation Attainable by Potential Methods of Electrical Exploration," *A.I.M.E. Geophysical Prospecting*, 1932.

Marcel Schlumberger: "The Application of Telluric Currents to Surface Prospecting," *Transaction Geoph. Union*, 20th Annual Meeting, part 3, p. 271, 1939.

D. Silverman and D. Sheffet: "Note on the Transmission of Radio Waves Through the Earth," *Geophysics* VII (4), October, 1942.

L. B. Slichter: "The Interprettaion of the Resistivity Prospecting Method for Horizontal Structures," *Physics* 4, 307, 1933.

L. B. Slichter: "Electromagnetic Model Response of Conducting Spheres," *A.I.M.E. Geophysical Prospecting*, 1932.

L. Statham: "Electric Earth Transient in Geophysical Prospecting," *Geophysics* I(3), June, 1936.

A. F. Stevenson: "On The Theoretical Determination of Earth Resistance from Surface Potential Measurements," *Physics* 5, 144, 1934.

Karl Sundberg: "Effect of Impregnating Waters on Electrical Conductivity of Soils and Rocks," *A.I.M.E. Geophysical Prospecting*, 1932.

G. F. Tagg: "The Earth Resistivity Method of Geophysical Prospecting," *Mine Journal* 43, 19, 1930.

G. F. Tagg: "Earth Resistivity Surveys," *Mining Magazine*, London V. 53, No. 3, pp. 148-154, 1935.

G. F. Tagg: "Interprettaion of Resistivity Measurements," *A.I.M.E. Geophysical Prospecting*, 1934.

G. F. Tagg: "Interpretation of Earth-Resistivity Curves," *A.I.M.E. Geophysical Prospecting*, 1940.

R. R. Thompson: "A Note on Seismic-Electric Effect," *Geophysics* IV(2), March, 1939.

R. Watson and J. F. Johnson: "On The Extension of Two Layer-Methods . . . of Earth Resistivity Data to Three and More Layers," *Geophysics* III(1), January, 1938.

R. J. Watson: "A Contribution To The Theory of The Interprettaion of Resistivity Measurements Obtained From Surface Potential Observations," *A.I.M.E. Geophysical Prospecting*, 1934.

P. Weaver: "Exploration Geophysics," *Oil Weekly*, April 8, 1940.

Warren Weaver: "Certain Applications of the Surface Potential Method," *A.I.M.E. Geophysical Prospecting*, 1929.

S. S. West: "Electrical Prospecting With Non-Sinusoidal Alternating Currents," *Geophysics*" III(4), October, 1938.

S. S. West: "Three-Layer Resistivity Curve in the Eltran Electrode Configuration," *Geophysics* V(1), January, 1940.

Thomas S. West and Clarence C. Beacham: "Precise Measurement of Deep Electrical Anomalies," *Geophysics* IX(4), October, 1944.

W. W. Wetzel and H. V. McMurray "A Set of Curves . . . of the Three-Layer Resistivity Problem," *Geophysics* II(4), October, 1937.

Stanley W. Wilcox: "Sand and Gravel Prospecting by the Earth Resistivity Method," *Geophysics* IX(1), January 1944.

Gifford White: "Application of Rapid Current Surges to Electric Transient Prospecting," *Geophysical Prospecting*," *A.I.M.E. Transactions*, 1940.

R. D. Wyckoff: "Geophysics Looks Forward," *Geophysics* IX(3), July, 1944.

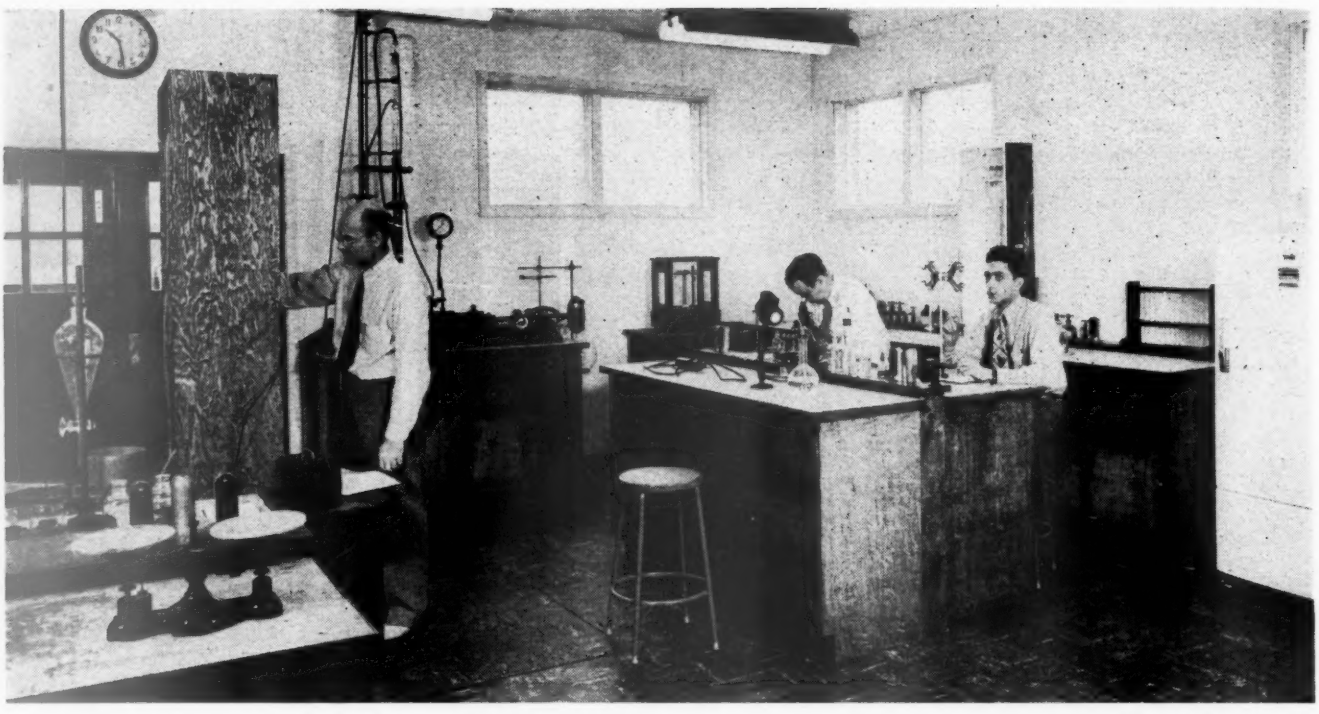
Theodore Zuschlag, "Mapping Oil Structures by the Sundberg Method," *A.I.M.E. Geophysical Prospecting*, 1932. ★ ★ ★

MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"
CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

Climax Molybdenum Company

500 Fifth Avenue · New York City

MOLY



General laboratory.

Physics research division broadens its activities

By G. M. WEBB*
W. S. GALLAWAY
M. J. MURRAY
C. H. EHRHARDT
Universal Oil Products Company

PART 2 (Conclusion)

Mass spectrometry

● Synopsis. *When a molecular compound is bombarded with electrons, the molecules are "cracked," and a large number of positively charged fragments is produced. The relative abundancies of the various fragments are, for a given set of operating conditions, unique for each compound. It is this property that is utilized in mass spectrometric work. The mass spectrometer provides a new tool for the quantitative analysis of complex mixtures of light hydrocarbon gases encountered in many petroleum refining operations. It is indispensable in determining the presence and identity of trace impurities in gases, such as butadiene, helium and oxygen, to mention a few. It can also be used in identifying the isotopes of various elements, such as those of carbon having masses of 12 and 13. This makes it possible to study mechanism of reactions by incorporating a small amount of a tracer isotope in the reaction mixture, and following the entire reaction by analyzing the reaction products for the tracer isotope by means of the mass spectrometer.*

The most recent addition to our physical research equipment is a mass spectrometer of the type manufactured by the Consolidated Engineering Corporation.

While the principles on which mass spectrometers operate have been known for over 30 years, it has only been in the last few years that rugged and stable instruments have become generally available. The early instruments, notably that constructed by Aston, were designed to permit accurate determinations of the mass of ions. These instruments were called mass spectrographs because the charged ions of different mass were allowed to fall on a photographic plate located within the evacuated instrument. The resulting mass spectrum could be used for accurate mass determination. The instrument that is set up in our Riverside laboratories is known as a mass spectrometer and, while mass determinations cannot be made very accurately with it, it does provide a means of determining with high precision the relative abundance of ions of different mass.

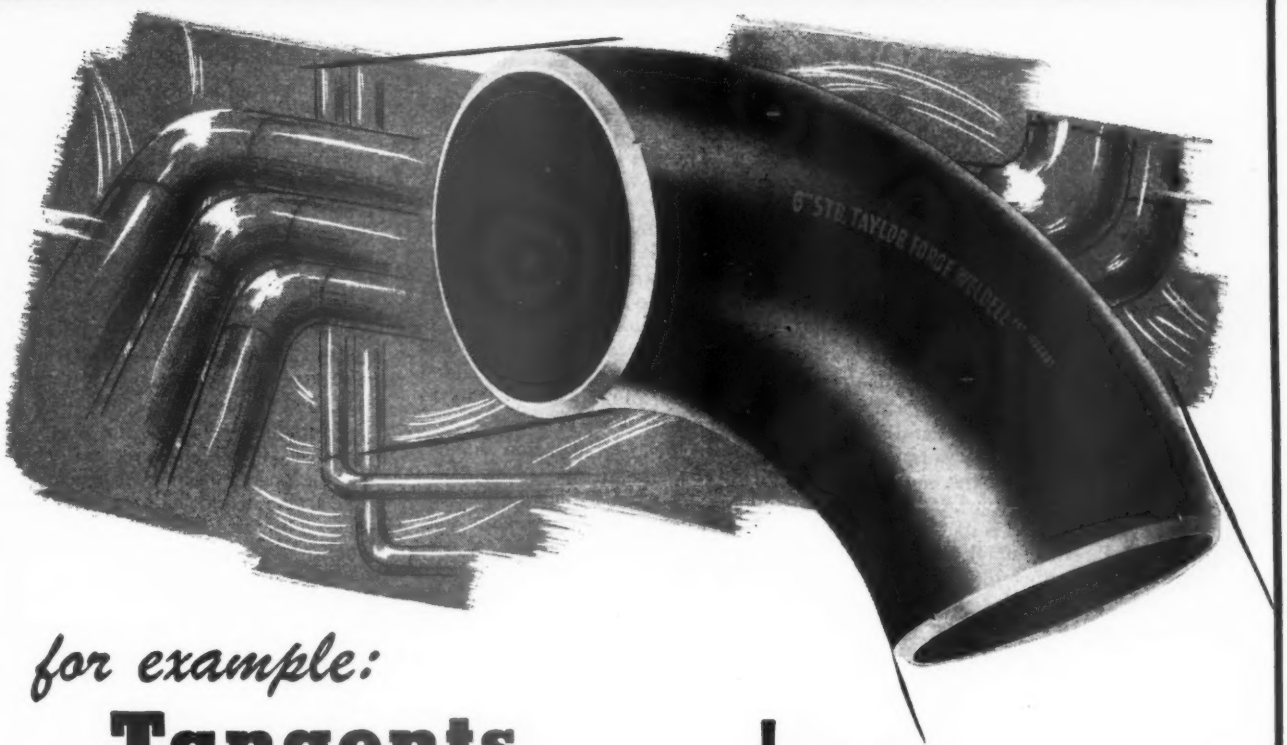
The reason it is important, in the petroleum industry, to be able to measure the relative number of ions of different mass accurately is due to the fact that when fast electrons (having energies of 50 volts or more) are directed into a hydrocarbon vapor at low pressures, the molecules are dissociated into a great many fragments. The relative number of fragments of different masses is quite independent of pressure in the range of 10^{-5} to 10^{-6} mm. Hg., and is unique for each molecular species. In other words, each hydrocarbon has a "mass spectrum" that is different from that of any other hydrocarbon. This situation is similar to that which exists, for example, in the case of infrared absorption spectra of different substances which has already been described. It is because of this characteristic behavior that the mass spectrometric method is so useful in detecting the presence of various compounds qualitatively, and analyzing mixtures quantitatively.

The Consolidated mass spectrometer consists essentially of the following components:

1. Ionizing chamber. The gas to be studied is fed into the ionizing chamber where the pressure is maintained at about

*Dr. Webb is director of the Physics Division, Universal Oil Products Company; the others are his associates.

WeldELLS



for example:

Tangents

If they did not have tangents, WeldELLS would not have *everything.* These straight segments on each end of every WeldELL achieve three things that only tangents can accomplish:

1. They make lining up easier
2. They keep the weld out of the zone of greatest stress
3. They facilitate the use of slip-on flanges

Providing tangents entails extra manufacturing operations, but this is simply typical of the extra-value you get in WeldELLS and other Taylor Forge Fittings for pipe welding.

A number of these extra-value features are listed here. Note that they are combined only in WeldELLS!

TAYLOR FORGE & PIPE WORKS
General Offices & Works: P. O. Box 485, Chicago
New York Office: 50 Church Street
Philadelphia Office: Broad Street Station Bldg.
Los Angeles Office: Oviatt Bldg.

WeldELLS alone combine these features:

- **Seamless**—greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends** — simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

have everything

10^{-5} mm. Hg. Electrons of about 50 volts energy are shot into the chamber from an electron gun. Impact of the electrons on the molecules of the gas causes them to dissociate. In the simple case of methane, it has been found that seven positively charged ions are produced under these circumstances with the following mass numbers and relatives abundances:*

Mass number	Ion	Relative abundance
16	CH_4+	100
15	CH_3+	78
	CH_2+	8
13	$CH+$	3
12	$C+$	1
2	H_2+	1
1	$H+$	1

2. *Accelerating zone.* After the ions have been formed in the ionizing chamber, they are all made to move in a given direction with the same kinetic energy, irrespective of mass. This is accomplished by applying a potential difference between two slits. This voltage difference can be varied from a few hundred to several thousand volts in the Consolidated unit. The ions thus leave the final slit having the same kinetic energies but different velocities or momenta. The mathematical relationship between the energy and velocity is $\frac{1}{2}\ mv^2 = Ve$, where m is the ion mass, v its velocity, e its charge, and V, the accelerating potential. The momentum is the product of mass and velocity, mv.

3. *Separation of the ions.* The moving ions are now made to enter a uniform and constant magnetic field. The magnetic field deflects the particles, causing them to move along circular paths, the radii of which are proportional to the momenta of the particles. The instrument is of the 180 degree focusing type, thus permitting the ions to traverse one-half of a circle. At the end of this circular path, the ions leave the magnetic field, and are made to fall on a collecting cage. For a given set of operating conditions, only one particular mass particle will fall on the collector. To make any desired mass particle reach the collector, it is necessary to change either the magnetic field, the position of the collector or the accelerating voltage. In practice, the accelerating voltage is varied. Thus, in actually running an experiment in which many ions, light and heavy, are present, it is the usual procedure to vary the accelerating voltage continuously from a high value of about 4000 volts to a low value of, say, 200 volts to permit ions from 1 to 200 mass units to reach the collector.

4. *Recording of the ions.* When the ions reach the collector, the charge on the ions is neutralized, since the collector is connected to ground through a high resistance. The ion current through the high resistance is amplified by a direct current amplifier, the output of which passes through four galvanometers of different sensitivities in series. Tiny beams of light are reflected from the galvanometers onto moving photographic paper, which provides a permanent record of relative abundances of all the ions present. A mass marker is also provided with the unit to afford an easy way to identify the actual mass positions.

The above brief description suffices to indicate the general operation of the instrument; it is admittedly complex, but the unit has been so well engineered that it has adequate stability for normal use.

In using the instrument for routine analysis of plant or test samples, it is necessary to obtain the mass spectrum of the unknown and also the spectra, or cracking patterns, of all of the compounds in the unknown. From these data the composition of the unknown may be calculated. As presently arranged, mixtures containing as many as 12 components can be analyzed.

In the determination of the purity of various materials, much can be done with the mass spectrometer that can be done in no other way. For example, it was recently shown that helium produced in government owned plants contains on the order of a half per cent of hydrogen which was a hitherto unrecognized impurity.† In addition to analyses of this type, it is usually very easy to establish the presence of elements heavier than the main constituent. In pentane, for example, the presence of hexanes and heavier materials can be rapidly confirmed. It is not so easy to learn whether lighter elements are present, since the main constituent may give rise to fragments that have masses identical to those of the impurity. In other cases this can be done, as, for example, the amount of nitrogen in oxygen, since the masses cannot be identical.

Liquids and solids can be studied by the mass spectrometer provided their vapor pressures are sufficiently high. Materials boiling above 100° C. have already been investigated, and there is no reason to suppose that much heavier materials cannot be studied. Eventually it is expected that even heavy metals may be examined, as all that would have to be added to the present instrument is a furnace that could be operated at a temperature high enough so that the vapor pressure of the material in question is over 10^{-4} millimeters of mercury.

Undoubtedly one of the most important uses to which mass spectrometers will be put in the next few years is isotope tracer work. There are several isotopes now available that should find countless applications in industrial research work, for following the course and mechanism of reactions and the like. The isotopes now fairly readily available include heavy hydrogen, chlorine, oxygen, nitrogen, and carbon.

An auxiliary instrument that is used in conjunction with the mass spectrometer is an electrical computer. When complex mixtures of hydrocarbons containing, for example, 12 components, are analyzed, it is necessary to solve 12 linear simultaneous equations for the actual quantities desired. This is a tedious task, and when done with the aid of an ordinary calculating machine consumes several hours. To speed up this process of calculation, an electric computer has been installed that permits the solution of linear simultaneous equations in about one-fifth the time formerly required. A photograph of this instrument is shown.

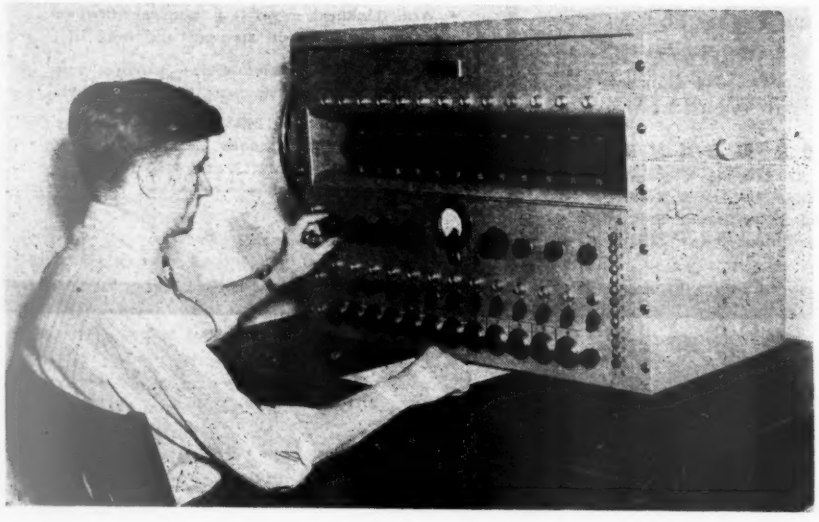
● **Emission spectroscopy.** The large Bausch and Lomb Littrow spectrograph rounds out the spectrographic facilities at U.O.P. This unit is primarily designed for the study of emission spectra in the ultraviolet, visible, and photographic infrared regions. Complete description of this type of instrument and its uses have been published in several books,—notable among them in Brode's "Chemical Spectroscopy."

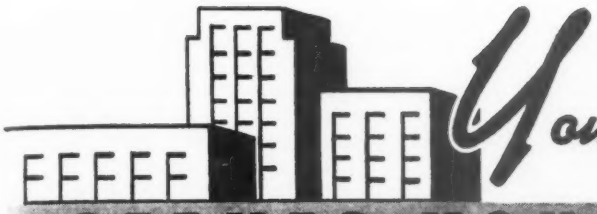
Being a Littrow spectrograph, its optical path is similar to that of the infrared and ultraviolet units. A few fundamental differences are to be noted, however. The first is that the source is an arc or spark in which the sample is placed. The resulting light emitted is not continuous in wave length (as is the

*L. G. Smith, Phys. Res. *51*, 263 (1937).

†A. K. Brewer, J. Res. Nat. B. Stds., *35*, 125 (1945).

Electrical computer.

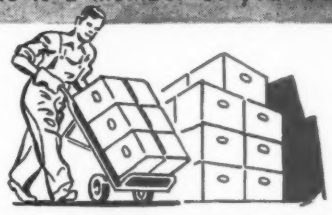




Your OIC valve distributor

SERVES YOU IN MANY WAYS

Your industrial distributor is a good man to do business with . . . a good friend to have in emergencies . . . a source of constant aid to your operations. He is a member of your business community, so he understands your problems and tries to anticipate your needs. He's close at hand when you need him. Here are just a few of the countless ways in which he serves you:



CONVENIENT STOCKS

Your OIC valve distributor knows your needs and tries to maintain his stocks accordingly. That enables you to keep your own parts and materials inventories low . . . saving you capital investment, storekeeping expense and loss from obsolescence.

ON-THE-SPOT TECHNICAL AID

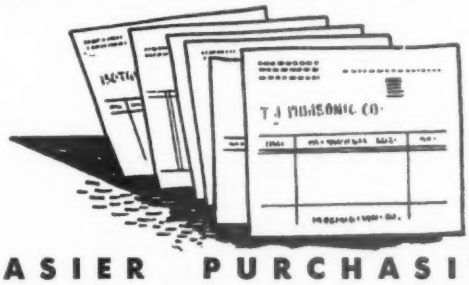
Years of experience in handling the problems of many industries makes the OIC valve distributor a valuable adviser. He knows the products that will do the best job under specified circumstances. He keeps abreast of latest technical developments.

IMMEDIATE INFORMATION

Just telephone your OIC valve distributor for immediate price and catalog information. He can either give you the answers right away or get them for you quickly . . . saving you time, trouble and lengthy correspondence.

SECURING SCARCE ITEMS

If anyone knows where to get an unusual or scarce item, it's your distributor. He knows where to look, and has many contacts. In times of shortages, the distributor's efforts along this line have been a most important service to his customers.



EASIER PURCHASING

Buying is centralized when you make full use of a distributor's services in buying valves and the wide variety of other items he carries. That means you place fewer orders, receive fewer invoices, simplify your bookkeeping and purchasing activities.

PRODUCT DEPENDABILITY

Your OIC distributor stakes his own reputation on the quality of the products he sells. When he recommends OIC valves, you can trust his advice, for he must provide products that perform dependably and are *right* for your particular installation.

Check your distributor first

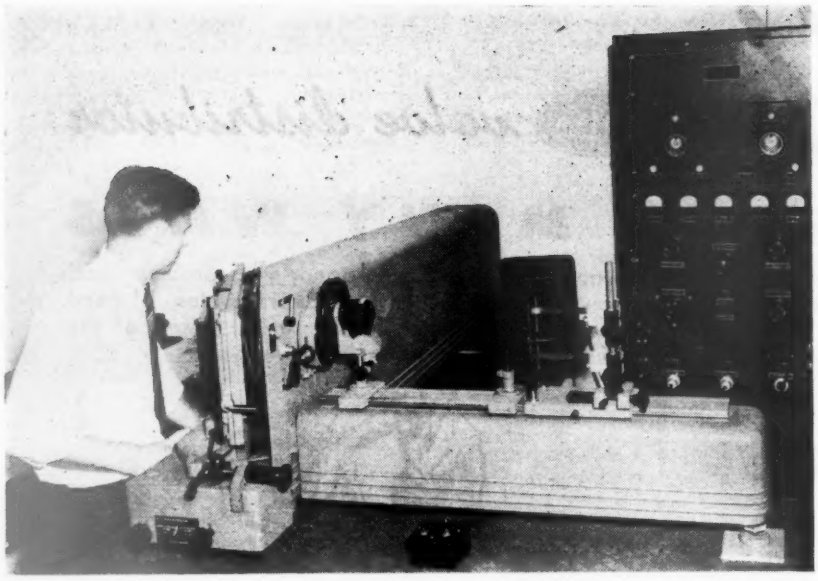
IT PAYS!

OIC

D-946-33

STEEL • IRON • BRONZE VALVES

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO



Emission spectrograph.

case with the infrared and ultraviolet sources) but is a series of many single wave lengths. The result is that the photographic plate on which the dispersed spectrum falls shows a set of lines,—each one being the image of the entrance slit for each wave length of light present in the source.

The particular pattern obtained is, as one might expect, characteristic of the sample placed in the arc or spark. However, it is characteristic not of the molecules or chemical compounds but of the elements present. The power of this analysis test lies in the positive character of the identification of the presence of given elements, its sensitivity to the minutest traces (less than 1 part per million), and the rapidity of obtaining results.

A photograph of the emission spectrograph in use in our laboratory is shown.

X-ray diffraction

● **Synopsis.** *X-ray diffraction offers a method of studying the arrangement of the atoms in all kinds of matter. By this method it is possible to distinguish between various crystalline forms of the same material, and between different states of hydration. X-ray diffraction also presents a method of measuring the average crystal size of powdered materials. A wide range of catalytic materials have been studied by this means. For example, studies by these methods on the transformations of Al_2O_3 under various conditions of heat treatment, aided greatly in the development of a superior hydroforming catalyst for the production of toluene for the war and for the improvement of post-war motor gasoline.*

The use of X-rays by the physician and dentist in diagnosis is familiar to everyone. The industrial use of X-rays in the radiographic examination of castings and welded pressure vessels is also well known. Another application of X-rays less familiar but very important is the study of the geometrical arrangement of the atoms in all kinds of matter by means of the diffraction of X-rays.

X-rays are produced whenever a beam of high speed electrons collide with any matter. A somewhat crude analogy may be obtained by comparing X-rays to the sound waves that are emitted by the impact on a brick wall of a stream of bullets from a machine gun.

The radiation from an X-ray tube is of two types. The first, the continuous radiation, used in radiography, is dependent only on the voltage applied to the tube. This component becomes harder, that is, the average wave length becomes smaller, with increasing voltage and it is therefore more penetrating. Thus, in the radiographic inspection of iron and steel it is usual to apply to the X-ray tube approximately 100,000 volts per inch of material thickness under test. The second type, the so-called characteristic radiation, consists of a few very narrow bands of wave lengths characteristic of the element comprising the target of the X-ray tube. These wave lengths are independent of the applied voltage so long as a certain minimum, characteristic for each element, is exceeded.

It is the characteristic radiation, as it does consist of a few very narrow wave length bands, which is primarily useful in the X-ray diffraction study of matter. Those elements whose radiations are most useful in this respect are copper, molybdenum, iron, cobalt, and chromium, although for some special problems others are sometimes used. The voltages used in X-ray diffraction work usually fall within the range of 20,000 to 50,000 volts.

The diffraction of X-rays as ordinarily observed is a consequence of the atomic nature of matter and the arrangement of the atoms in regular geometric manner. In crystalline matter it is somewhat simpler to consider the atoms to be arranged in sheets and the crystal to be built up by piling these sheets on one another in regular manner. Examples of these sheets or planes of atoms are the cleavage planes of mica and the natural faces of crystals of quartz, calcite, or rock salt. In real crystals there are numerous sets of parallel planes that pass through the crystal so that all atoms in the crystal will then lie in one or another of the planes of each set. The diffraction of X-rays by crystals may be considered as the reflection of the X-rays from the planes of atoms within the crystal, just as ordinary light is reflected from a plane mirror. There is, however, a distinct difference; whereas ordinary light is reflected from a plane mirror for all angles of incidence, X-rays will be reflected from the planes of atoms within a crystal only for certain definite angles of incidence that satisfy a mathematical relationship between the wave length of the X-rays, the angle of incidence, and the distance between the successive members of the particular set of planes in question. This fundamental law of X-ray diffraction discovered by W. H. Bragg in 1912 and known as Bragg's Law, is given by the relation

$n\lambda = 2d \sin \Theta$ — where n is an integer.

λ is the wave length of the X-rays.

d is the distance between the planes.

Θ is the angle between the incident X-ray beam and the reflecting plane.

Since most industrial materials are polycrystalline, that is composed of many small crystallites, the most important method of X-ray diffraction examination of materials is the so-called powder method developed independently by Debye and Scherrer in Germany and Hull in America in 1916. In this method of examination, a narrow beam of characteristic radiation is defined by means of a system of slits. The beam is caused to fall on a very small sample of the material to be investigated. The specimen may be in the form of a fine wire, a fine powder contained in a very thin walled glass or plastic capillary, or as a paste coated on a thread or a fibre. The sample is surrounded by a photographic film in the form of a cylinder, with the sample at the center.

When the X-rays strike the sample there will be certain of the small crystallites that will be so oriented to the X-ray beam that some one set of planes within the crystallites will fulfill the condition of Bragg's Law and will therefore reflect some of the incident X-rays. In a fine powder all possible orientations of crystallites with the X-ray beam are equally probable. Thus other crystallites will have the same orientation with respect to the X-ray beam except for a rotation about the axis of the beam, and, therefore, there will occur a cone of reflected radiation centered about the incident X-ray beam. The reflected radiation making up this cone will be due to contributions from a very large number of small crystallites each having the same orientation except for a rotation about the incident beam.

Other crystallites will be so oriented that some other set of planes will fulfill

Chrysler Industrial Power is *Earning Power*

Owners of powered industrial equipment in many types of applications depend on Chrysler Industrial Engines to do the job in estimated time—and economically, too.

Rugged, precision-built—compact, low in weight—economical and long-lived because of Chrysler Superfinishing of moving parts, Chrysler Industrial Engines come through, bringing owners and operators real *earning power.*

Be sure you have Chrysler "Pedigreed" horsepower in your industrial equipment. Write to the Chrysler Industrial Engine Division for information or send in the coupon for the Industrial Engine catalog.

Some Applications of Chrysler Industrial Power

Arc Welders	Industrial Lift Trucks
Air Compressors	Industrial Pumps
Booster Pumps	Industrial Tractors
Concrete Mixers	Mechanical Shovels
Cranes	Motor Coaches
Crane Carriers	Portable Sawmills
Crane Loaders	Portable Well Drillers
Farm Tractors	Road Rollers
Fire Pumps	Self-propelled Farm Combines
Fuel Oil Pumps	Soil Pulverizers
Gang Mowers	Street Flushers
Generator Sets	Winches

Moving material—fast—is easy for this sturdy machine.
It's powered by a Chrysler Industrial 6 Engine.

CHRYSLER
INDUSTRIAL ENGINES

Horsepower with a Pedigree

Industrial Engine Division, Chrysler Corp.
12203 East Jefferson, Detroit 31, Michigan

Please send the Chrysler Industrial Engine Catalog.

Name _____

Address _____

City _____ State _____

10

the Bragg Law and will contribute to a second cone of reflected radiation. Thus there will be produced a set of cones of reflected radiation corresponding to all of the various sets of planes within the crystal capable of satisfying the Bragg Law. The intersection of these cones of reflected radiation with the cylindrical film results in a series of curved lines on the developed film. This line set is called the diffraction pattern. Measurement of the distances between corresponding lines allows the angles of reflection to be calculated. Then from Bragg's Law the various "d" values may be calculated. It is these "d" values together with the intensity of the various corresponding lines that characterize the sample.

The X-ray diffraction pattern of a substance is determined by the arrangement of the atoms in the substance. Anything that disturbes or alters this arrangement produces a change in the diffraction pattern and is thereby a subject that may be profitably studied by X-ray diffraction methods.

X-ray diffraction offers a method of chemical identification as each compound has its own characteristic diffraction pattern. It is possible by X-ray diffraction to distinguish between different crystalline forms of the same element or compound. It is usually possible to distinguish between the various states of hydration that may exist and to differentiate between water of hydration and water that is held only by adsorption.

As an example, consider the compound alumina (Al_2O_3), which is very important in catalytic work both as an activator and as a catalyst base. It also has important uses as a drying agent. There are at least two forms of anhydrous Al_2O_3, corundum or α-Al_2O_3 and γ-Al_2O_3. Corundum has no catalytic activity; it is used for abrasives and refractories. Single crystals of α-Al_2O_3 under the name of sapphire are used as jewels in watches and electrical meters, and as phonograph needles. γ-Al_2O_3 is very widely used as a catalyst or catalyst base.

There are two forms of alumina monohydrate ($Al_2O_3.H_2O$), Diospore and Böehmite. Diospore occurs in nature but has never been produced synthetically except by seeding the reaction mixture with crystals of the natural material. Böehmite is the material that is usually formed when an aluminum salt is reacted with a base to precipitate alumina. It also occurs in nature.

There are also two forms of alumina trihydrate ($Al_2O_3.3H_2O$). Bayerite and Gibbsite. Bayerite may be produced by the hydrolysis of sodium aluminate solution or by allowing Böehmite to stand in contact with cold dilute alkali solutions. Gibbsite occurs in nature and may be produced synthetically by continued contact of Bayerite with cold dilute alkali solution or more generally by seeding of sodium aluminate solutions into which CO_2 is then passed. e.g. the Bayer process.

All these different forms of alumina have been identified and their transformations from one form into another under various chemical and thermal treatments have been studied by means of powder X-ray diffraction photographs. X-ray studies of this kind have aided in developing methods of preparing alumina base catalysts that are much more resistant to high temperature without loss of activity due to a change in the structure of the alumina.

X-ray diffraction offers a method of measuring the particle size or more correctly the crystallite size in the submicroscopic range. The measurement is based upon the fact that the widths of the diffraction lines in a powder photograph increase with decreasing crystal size. The relation between the breadth of the lines and the crystal size has been worked out by Von Laue and others. The line breadth is measured on a microphotometer. This instrument projects a very narrow beam of ordinary light through the developed X-ray photographic film and measures the amount of light that is transmitted through the film and then draws a graph of the amount of transmitted light for each point along the film. From such a graph it is possible to determine the width of the X-ray diffraction lines on the film and when corrections are made for the size of the sample and size of camera to calculate quite simly the average size of the crystallite comprising the sample. This is very important in catalytic work since it is usually found that catalyst activity has a very great dependence on crystallite size.

A photograph of our Leeds and Northrup microphotometer is shown.

The preceding discussion has all been concerned with materials that are crystalline in nature. More recently methods have been developed whereby the particle size of amorphous substances that give no X-ray diffraction pattern in the usual sense may be studied.

Recording microphometer.

● **Electron microscopy.** The electron microscope has made visible an entirely new realm of previously invisible objects. Magnetic coils acting on a beam of high speed electrons permit objects that are only one-one hundredth of the minimum size visible in the best optical microscopes to be photographed. The construction of the electron microscope is entirely analogous to the ordinary optical microscope. There is a source of "light," a condensing lens to focus the light on the specimen, an objective lens, a projector lens and finally a camera to record the magnified image.

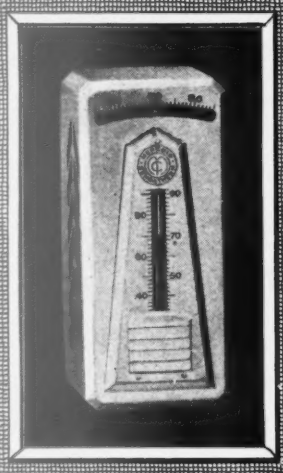
The light source is an electron gun. This consists of an incandescent tungsten filament, which supplies the electrons, and an anode which is a perforated disc. A high potential of around 50,000 volts is applied between the filament and the anode to impart a high velocity to the electrons that pass through the hole in the anode into the condensing lens.

The condensing lens is a cylindrical magnetic coil completely encased in iron except for a small gap in the tubular iron core along the inside of the coil. The magnetic field across this gap constitutes the magnetic lens. This magnetic lens acts on the electron beam in an exactly analogous manner to the ac-

OIL REFINING AND
CHEMICAL PLANT
Equipment
MADE TO ORDER
Pressure Vessels
Towers
Tanks
Plate Work
Special Machinery
ANY ALLOY • ALL CODES
Rail and Water
SHIPMENTS
SUN SHIPBUILDING
AND DRY DOCK COMPANY
Since
1916
MAIN OFFICE AND PLANT
CHESTER, PA.

FOR THE HOME

MERCOID SENSATHERM
THE THERMOSTAT OF
BEAUTY, MECHANICAL
PERFECTION AND IDEAL
LIVING ROOM COMFORT



MERCOID

The Mark of Craftsmanship in Automatic Controls
for nearly a quarter of a century

MERCOID PRESSURE AND
TEMPERATURE CONTROLS
HAVE A WIDE RANGE OF
INDUSTRIAL APPLICATIONS

★ MERCOID CONTROLS ARE EQUIPPED WITH SEALED MERCURY CONTACT SWITCHES THEY ELIMINATE ALL CONTACT TROUBLE ★
Catalog sent upon request
★ THE MERCOID CORPORATION 4203 W. Belmont Avenue, Chicago, Ill. ★

FOR INDUSTRY

tion of a glass lens on a beam of light. This condensing lens concentrates the electron beam onto the specimen to be examined.

The objective and projector lenses are constructed similarly to the condensing lens and perform the same function as the analogous lenses in the optical microscope. The final image may be viewed on a fluorescent screen or may be recorded on a photographic plate.

As the process of image formation is by means of transmitted electrons, the entire apparatus must be evacuated to a very low pressure to avoid collisions of the electrons with gas molecules. The specimen support must also be transparent to the electron beam. This means that it must be very thin, of the order of one-millionth of an inch thick.

The usual support is a film of collodion made by placing one drop of a solution of the material in a suitable solvent onto a water surface. The solution spreads out under the action of the forces of surface tension, and evaporation of the solvent leaves an invisible film of the plastic floating on the water surface. Small sections of this film are then picked up on ⅛ in. discs of 200 mesh screens. These are the mounts on which the specimens are placed for examination in the microscope. The actual specimen may be placed on the film by making a very dilute dispersion of the material in a volatile liquid and then placing a drop of this liquid on the mounted film and allowing the liquid to evaporate. Occasionally it is more desirable to incorporate the sample into the collodion solution and thus to disperse the particles in the process of formation of the film. Other methods are sometimes used depending upon the nature of the material to be examined.

The final photograph is in all respects similar to pictures taken with the optical microscope. The principal difference is the amazingly greater detail discernible in the electron microscope picture.

The electron microscope has found application in many fields of endeavor. In the field of medicine and biology it has enabled research workers to see for the first time some of the viruses that cause disease and to observe some of the processes by which nature attacks and destroys bacteria and viruses in the blood stream of a living animal.

In the field of metallurgy, techniques have been developed whereby replicas of polished and etched metal surfaces may be examined with the electron microscope. These pictures have furnished much new information on the structure, formation, and physical properties of metals and alloys.

In the field of catalysis the electron microscope has furnished a method of studying the particle size and shape of catalyst supports. Examination of catalyst promoters prepared by different methods has led to improved catalyst performance by indicating preferred methods of preparation of catalysts. In some cases it has been possible to observe the manner in which single crystals of the catalyst activator are attached to the support. Every bit of such knowledge when combined with information from other studies eventually leads to improved catalysts and catalyst performance.

Many of the electron microscopes, most of which are the R.C.A. Type B instrument, have been provided with a special adapter to permit the study of materials by the electron diffraction method as well. Electron diffraction patterns are produced and are interpreted in an analogous manner to X-ray diffraction patterns and, in general, yield much the same sort of information. There is, however, this difference: X-rays in general will penetrate the whole body of the sample and will therefore give a diffraction pattern that is characteristic of the crystal structure of the whole volume of the crystallites. The electron beam on the other hand is able to penetrate only very thin layers of matter and will therefore give a diffraction pattern that is more characteristic of the surface layers of the specimen. As catalysis is mostly a surface phenomenon the difference is important and makes electron diffraction and X-ray diffraction complementary tools for study of materials.

● **General physico-chemical work.** In addition to the above, the building includes a general laboratory in which physico-chemical studies on catalysts, oils, etc., are carried out. The equipment installed in this laboratory includes an Andrews' apparatus for studying the P-V-T relations of hydrocarbons and their critical properties, a surface area unit that is used for determining the surface properties and pore size distributions of catalysts, several optical microscopes, a fairly extensive supply of the chemical glassware, etc., used in preparing catalysts on a small scale, and a group of muffle furnaces for calcining catalysts at temperatures up to 2500°F. in various atmospheres.

As typical of the work done on catalysts in this laboratory may be cited the development of a metallic aluminum catalyst for the catalytic dehydrofluorination of alkyl fluorides. Such a catalyst was desired, for in the hydrogen fluoride alkylation process a small amount of hydrogen fluoride remains in the finished alkylate in the form of alkyl fluorides. In the prosecution of this project, a small laboratory test unit was constructed in which alkylate containing combined hydrogen fluoride could be passed over solid contact materials, to determine their efficiency in splitting off the combined HF. The catalyst finally developed consisted of 1 in. raschig rings made from metallic aluminum strips. The rings were made active for dehydrofluorinating alkyl fluorides by etching them in a solution of hydrochloric acid, washing and drying. These rings have been used in large quantities in several alkylation plants and have resulted in the recovery of hydrogen fluoride valued at many thousands of dollars. ★★★

This is the conclusion of the article by Dr. Webb and his associates on the physics research division.

MACHI*New and Improved*PMENT

A REGULAR FEATURE
appearing in
THE PETROLEUM ENGINEER
700 Irwin-Keasler Bldg.
Dallas 1, Texas

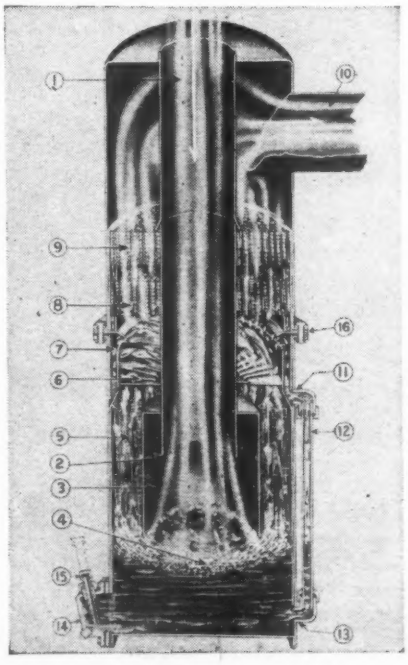
(1) *Air cleaner*

Continental Air Filters, Inc., 2550 Helm Street, Louisville, Kentucky, has announced its new Whirlwind Oil Bath Air Cleaner and Silencer, designed for diesel and gas engines, and air compressors.

According to Wm. K. Gregory, president, the Whirlwind Cleaner has six important features: (1) Visual oil circulation, (2) adjustable oil level, (3) positive scrubbing action, (4) demountable construction, (5) center tube intake, and (6) side outlet.

The Whirlwind is the first oil bath cleaner to offer, as standard equipment, a visual means of checking oil circulation, Gregory states. This permits the operator to determine easily whether the cleaner is functioning properly.

Inasmuch as the resistance of this type oil bath air cleaner increases as the oil level is increased, it is highly desirable to maintain the oil level at the lowest point that will give good oil circulation. With an adjustable oil level gauge, and visual means of checking circulation, the proper operating level may be readily established and maintained in the Whirlwind Cleaner, it is asserted.



After the air passes downward through the center tube, and its initial impingement with oil in the bottom of the cleaner, it passes through an 8-in. thickness of coarse-mesh hardware cloth, carrying a large amount of oil with it. Here a vigorous scrubbing action occurs, driving the dust particles into the oil, after which the oil is thrown from the air stream by the centrifugal action imparted by stationary "whirling-vanes." An exceptionally high cleaning efficiency is obtained.

The Whirlwind Cleaner can be completely demounted for inspection or repairs, by unbolting and removing the top portion.

The principal advantage of the center tube intake is that it permits the air intake to be elevated, as much as desired, above the heaviest dust concentration at ground level; also that the cleaner may be mounted inside the engine room, with the intake extended above the roof.

It is usually more convenient and less expensive to install a cleaner having a side outlet than one having a top outlet, the manufacturer asserts. Lower resistance to air flow is also obtained by eliminating a 90-deg. elbow with its inherent friction loss, it is stated.

Whirlwind Cleaners are made in five sizes with capacities from 600 to 6500 cu. ft. per min.

Keep Posted on
NEW EQUIPMENT
Use Card

Advancements in petroleum and plant equipment are being made rapidly. Keep abreast by making full use of *The Petroleum Engineer's* enlarged New Equipment Section.

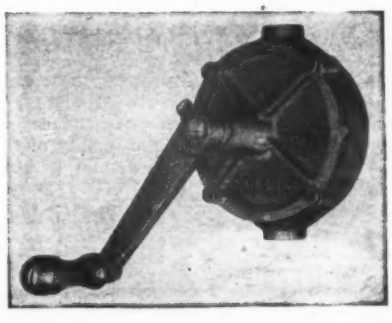
All items are numbered. A business reply card requiring no postage if mailed within the United States is provided. Check or encircle the number on the card that corresponds with the product or products in which you are interested and drop it in the mail. Literature and prices will be sent promptly on receipt of card.

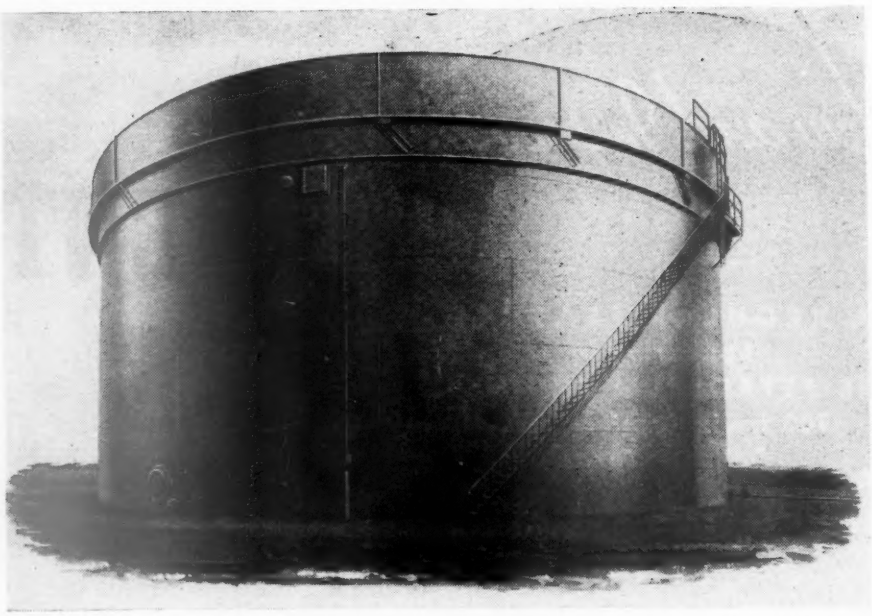
(2) *Rotary hand pump*

Features of a new rotary hand pump designed by Bowser engineers and on which laboratory and field tests were recently completed, are set forth in a release by J. B. Trotman, general manager of the Industrial Pump Division of Bowser, Inc., Fort Wayne, Indiana.

This new rotary pump has a capacity of 10 gal. per min. at a normal cranking speed and is of the vane type with an aluminum rotor, graphite vanes and stainless steel springs. Suction and discharge ports are threaded for 3-4 in. iron pipe. The rustproof working parts are said to eliminate the "freezing" action of rust due to condensation within the casing when the pump is not used frequently.

Production began October 1. The pump is supplied as "pump only," as a barrel pump with suction pipe, bung attachment and spout, and as a complete refueling unit with discharge pipe, combination hose holder and vacuum breaker, gasoline hose and aluminum nozzle.





(3) *Vapor-lift tank*

To Socony-Vacuum Oil Company, Inc., and Hammond Iron Works engineers must credit be given for the design, development, manufacture, and success of the latest Hammond Iron Works vapor-lift tank, which was given every known test at the Charleston, West Virginia, terminal of Socony-Vacuum.

The vapor-lift tank installation was erected for full liquid storage capacity and in addition to function as the "lung" that stores the vapors generated in the three cone roof tanks to which the vapor-lift tank is connected. Without this vapor-lift tank the vapors formed in the three cone roof tanks would be exhausted into the atmosphere with an attendant loss in quality as well as quantity.

The simple mechanism, which directs and stabilizes the upward and downward movement of the roof, consists of nothing but a track placed at regular intervals at an angle of 45 deg.; a roller guide rides in this track and other roller guides, placed at 90 deg. to the rollers in the tracks, ride against the side of the tank and take any lateral load such as from high winds. The bearings of the roller guides are self-lubricating to minimize maintenance and repair. This simple stabilizing mechanism prevents binding of the tank roof even under conditions of unequal loads caused by snow, ice, settled tank foundations, etc.

The vapor-lift tank installation at Charleston has two pressure regulators, the first being set at 2 oz. per sq. in. and the second at 2½ oz. The lifting pressure required to raise the roof is 1¾ oz. per sq. in. The actual differences between the pressure required to lift and drop the roof is 0.05 oz. per sq. in. This indicates very low friction loss. The second pressure regulator was installed to accommodate exceptionally high in-pumping rates.

Hammond vapor-lift tanks can be built to capacities of 100,000 bbl. to provide a variable vapor space of ample capacity to permit the expansion or contraction of vapors, to eliminate tank breathing losses, reduce filling losses, and maintain the quality of the stored product in one or a number of cone roof tanks.

(4) *Motor grader*

Production of the "Caterpillar" diesel No. 212 motor grader, suspended during World War II to permit increased manufacture of products most urgently needed by the armed forces, has been resumed by Caterpillar Tractor Company, Peoria, Illinois.

Powered by a rear-mounted, 35-b. hp., 4-cylinder, 4-cycle "Caterpillar" diesel engine the 212 motor grader is made available in both tandem and single drives. Normally equipped with 10-ft. moldboard and leaning front wheels, it has the traction, strength, and blade positions to do a complete range of blade work, and positive-acting, precision made mechanical power controls provide fast, easy operation of all blade and scarifier movements.

Smallest of three sizes of "Caterpillar" Series "12" motor graders, the No. 212 is built primarily for those whose work requirements do not warrant purchase of the larger models.

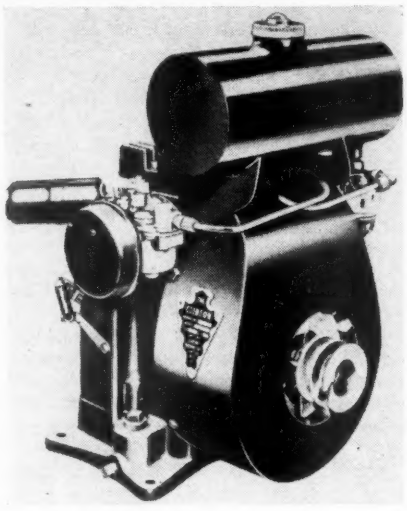
Specification sheets are available.

(6) *All-purpose engine*

For all uses requiring compact power, the Clinton No. 700 4-cycle air-cooled engine is announced by the Clinton Machine Company, Clinton, Michigan.

Economical, light-weight and easy to operate, this Clinton all-purpose gasoline engine is available for immediate delivery to power such widely-varied units as tractors, grain loaders, high-pressure pumps, boats, compressors, spray equipment, belt conveyers, power plants, and motor scooters, both for business and pleasure.

The Clinton Model 700 engine is also to be had in special types for special needs.



(5) *Informative series*

The accompanying photograph shows the first five pieces of a series of 18 informative articles prepared by Core Laboratories, Inc., explaining core analysis and other services in the field of petroleum reservoir engineering, offered by the company. Reading clockwise the photograph shows Jones No. 5 explaining permeability; the core analysis price schedule; Core Lab's File Folder in which the series can be conveniently filed; Smith No. 8 discussing relative permeability, and a pictograph of Core Lab's operations. The center piece, the "Good Oil Report" showing a Core graph, is a fascimile of a core analysis report and fluid analysis report. New information will be developed each month until the series is complete.

Superior PTD DRILLING ENGINE

It's modern to the minute and rugged as they come!

Construction throughout is unusually rugged, with ample factors of safety in all parts. The engine is started in a few seconds by compressed air to all cylinders, and full load power is available at once. Lubricating oil consumption is exceptionally low and the engine operates efficiently on a wide range of fuels. Horsepower ratings of 280 for the 6 cylinder model and 375 for the 8 cylinder model are very conservative, providing ample reserve power for occasional overload or sudden emergency.

The engine is fully enclosed, with dust-proof and oil-tight covers. Working parts are entirely accessible, as these covers can be easily and quickly removed from the large frame openings to permit easy inspection, quick adjustment or infrequent replacement. All the parts normally requiring service are light enough in weight to permit handling by one man.

THE NATIONAL SUPPLY COMPANY

GENERAL SALES OFFICES: TOLEDO, OHIO • DIVISION OFFICES: DENVER • FT. WORTH • PITTSBURGH • TULSA • TORRANCE. EXPORT: NATIONAL SUPPLY EXPORT CORPORATION, 30 ROCKEFELLER PLAZA, NEW YORK, N. Y., U. S. A. • RIVER PLATE HOUSE, 12 SOUTH PLACE, LONDON, E. C. 2.

First in Quality — THE NATIONAL SUPPLY COMPANY — NATIONAL BLUE PRODUCTS

to *Corrosion* costs?

One of the largest petroleum companies in the world uses Amercoat plastic coatings for corrosion control in their refineries.

The illustration below shows a battery of 12 ammonia condensers, a part of the refrigeration plant. All of the structure visible in the photograph has been coated with Amercoat. Sea water is used as a coolant and the entire structure is subject to constant salt spray, as well as ammonia and acid fumes.

Previously, in spite of regular painting and maintenance, corrosion continued and was approaching an operation danger point due to high tank operating pressures. After Amercoat was applied in July, 1944, there was no further maintenance, yet two years later all tanks and piping showed no signs of further corrosion—stairs, walkways and other structures subject to mechanical and manual abrasion showed a minimum of corrosion.

Amercoat plastic coatings applied cold by brush or spray to metal, concrete or wood act as a barrier to corrosive action encountered in the petroleum industry—salt water, hydrogen sulphide, caustic soda, sour crudes, sulphuric acid, and many other corrosive salts, acids and alkalies.

Write for details and names of users.

IN THE PETROLEUM INDUSTRY IT'S

Amercoat

Ask for Booklet 2-B

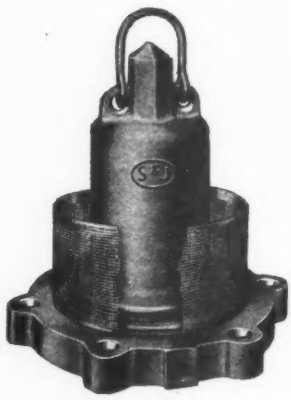
AMERCOAT DIVISION:
AMERICAN PIPE & CONSTRUCTION CO.
P.O. Box 3428, Terminal Annex
Los Angeles 54, Calif.

(7) *Safety valve*

A new internal safety valve for truck tank compartments that may be operated either hydraulically or by the compressed air of the truck brake system has been announced by Shand and Jurs Company of Berkeley, California.

The new valve is opened either by hydraulic or air pressure and closes under spring tension. The design incorporates a synthetic O-ring between the piston and the cylinder wall, and the valve may be removed from the tank through the compartment dome cover rather than from the bottom of the tanks.

Any number of valves from one to twelve per truck tank may be actuated by a new hydraulic operator, which is in essence a hydraulic pump, or from the compressed air line of the truck.



(9) *Housing seal*

A newly designed housing seal for roller bearing units has been announced by the Shafer Bearing Corporation, 412 West Washington Boulevard, Chicago, Illinois.

Called the "Z" Seal, this new device was developed as a housing seal that would effectively retain lubricant and keep dirt out. The "Z" Seal consists of five parts. The seal element fits on an extension of the inner bearing race with minimum running clearance, providing an almost frictionless seal. The seal element is held under moderate tension yet is permitted to float radially, thus correcting for radial displacement from any cause. Brass construction is used in two parts to prevent corrosion and to provide natural bearing material during momentary contacts with the inner bearing race. The entire unit is easily removed and dissembled into its component parts. The "Z" Seal is supplied as standard equipment without extra charge on all Shafer roller bearing units.

On the basis of performance in several thousand installations, the "Z" Seal has demonstrated an exceptional degree of efficiency, it is asserted. This entirely new type of seal has been adapted as standard equipment by many of the larger industrial plants and original equipment manufacturers. A descriptive folder is available on request.

(8) *Alco evaporators*

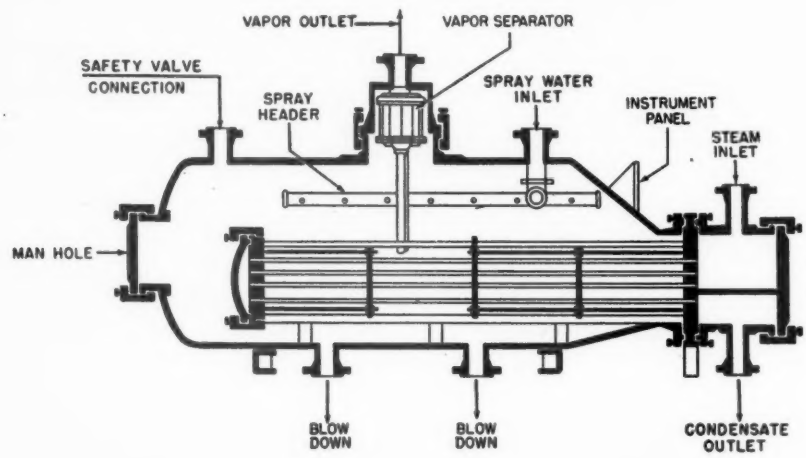
Demand for effective water purification systems for industrial purposes has increased measurably in recent months and probably will continue to rise as industry strives to get into full production, according to Hugh M. Corrough, director of American Locomotive Company's Alco Products Division.

Construction of new plants, relocation of others closer to favorable markets, and continued conversion of war-surplus plants to production of peacetime goods and services were among chief factors cited by Corrough as leading to increased interest in evaporators.

As one of the largest shell and tube heat exchanger manufacturers, American Locomotive Company is currently active in solving evaporation problems in collaboration with the planners of new projects. Production is now high, and Alco anticipates little difficulty in meeting delivery requirements for evaporators; however, like most manufacturers, Alco is hampered by shortages of materials, but, these are not critical enough to interfere markedly with production schedules, it is asserted.

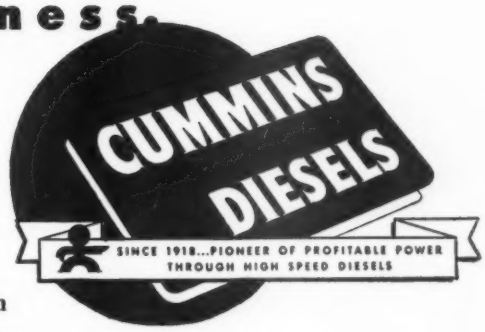
To answer many inquiries regarding Alco evaporators, American Locomotive Company has just issued an interesting booklet featuring its evaporator "flex-tube" design, which, the company says, is "the only positive acting true thermo-mechanical descaling device for straight tube installation."

Alco evaporators have been in continuous service since 1930 when the first units were placed in operation. The latest units operating at design capacity, are delivering water vapor with solids of less than 1 p.p.m.



*dependable

is more than a word with us . . . it's our way of doing business.



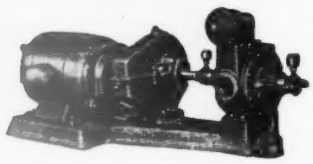
*Specify a Cummins Diesel and you can depend upon prompt and competent service from a nationwide dealer organization. You can depend upon the Factory to stand behind that engine throughout its entire work-life. You can depend upon all this because with Cummins, **dependable** is more than a word . . . it's our way of doing business.

CUMMINS ENGINE COMPANY, INC., COLUMBUS, INDIANA

PUMPS
for the
PETROLEUM
INDUSTRY

Write for Bulletin No. 102
which shows why and how

BLACKMER PUMPS
are SELF-ADJUSTING FOR WEAR



Gathering Pumps • Refinery Pumps
Bulk Station and Truck Pumps
Hand Pumps • Suction Line Strainers
Capacities to 750 GPM—Pressures to 500 psi.

BLACKMER PUMP COMPANY
1980 Century Avenue Grand Rapids 9, Mich.

SERVING THE PETROLEUM INDUSTRY FOR 40 YEARS

"...and a group of us could team up to OPERATE THIS PLANT"

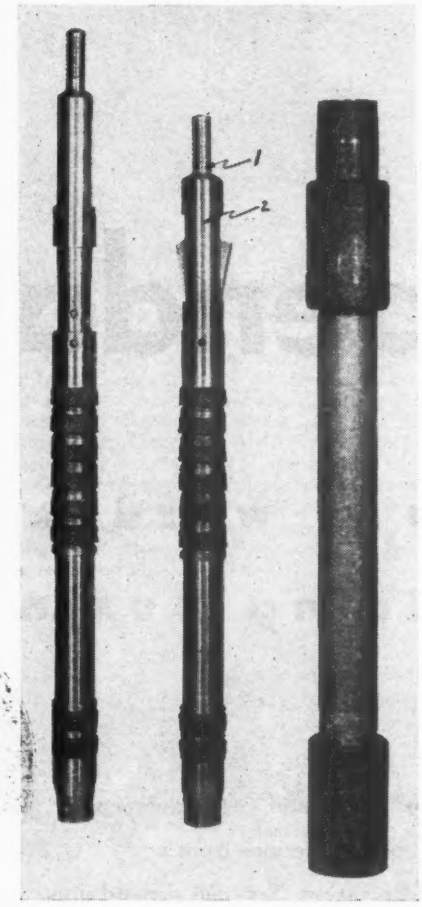
See Page 34

(10) *Halco locking device*

The Halbert Company, Fort Worth, Texas, announces the development of the Halco Locking Device, to be used with its Halco Fluid Seal installation to reduce excessive gas-oil ratios. The device permits installation and removal of the fluid seal assembly on a wire line, after the seating nipple is run in the tubing. Descriptions of the Halco Locking Device and Halco Fluid Seal follow:

Halco Locking Device. Shown from right to left in the accompanying illustration: Locking nipple and coupling, seating nipple, and landing coupling as they are run in the tubing; tool in locked position with lugs out as they would be under the locking shoulder; tool after locking pin has been sheared, allowing sleeve to travel up and unlock lugs, ready to come out of the hole.

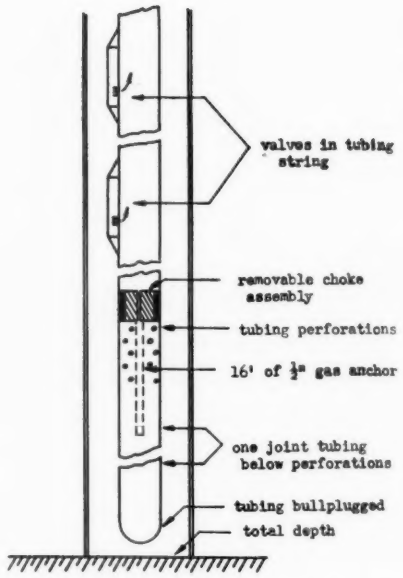
The choke and 16 ft. of ½-in. gas anchor screw into the bottom of the tool. The whole assembly is run in on a wire line by means of a socket attached to the tool with a 3/32-



in. shear pin at point No. 1. When the tool is locked in place, this running pin is sheared with a light stroke of the jars.

The sleeve is secured in its downward (running and locking) position by a 5/32-in. shear pin at point No. 2. To remove the assembly from the well, a rod socket engages the tool crown, the 5/32-in. pin is sheared with the jars, and the sleeve travels up and unlocks the lugs from the shoulder, allowing the tool, choke, and gas anchor to be pulled.

Halco Fluid Seal. The accompanying schematic diagram shows the Halco Fluid Seal. The patented fluid seal, in brief, is simply a gas anchor in conjunction with a bottom-hole choke and necessary gas-lift



valves in the tubing string to lift the oil to the surface. In wells of applicable characteristics it has proved very efficient in controlling high gas-oil ratios, removing thereby the penalty on the well's allowable, according to the manufacturer.

By maintaining a fluid seal on the tubing, and admitting through the valves only the small volume of gas needed to lift the comparatively gas free fluid, the excessive gas volumes formerly required to produce the well are materially reduced, the makers state. With the recent development of the Halco Locking Device, the operator can install and remove the entire fluid seal assembly on a wire line after the seating nipple is run in the tubing, it is stated.

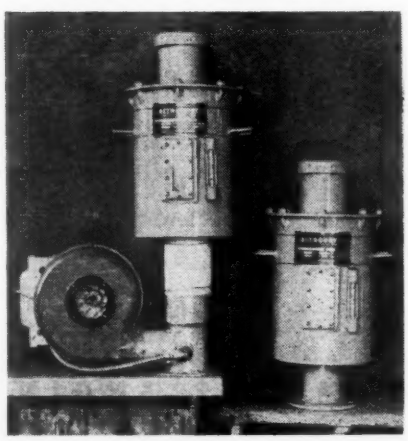
(11) *Tank breathers*

Pittsburgh Lectrodryer Corporation, Pittsburgh, Pennsylvania, announces that a large part of its current production is being concentrated on a newly improved line of breathers especially designed for industrial organizations employing storage tanks.

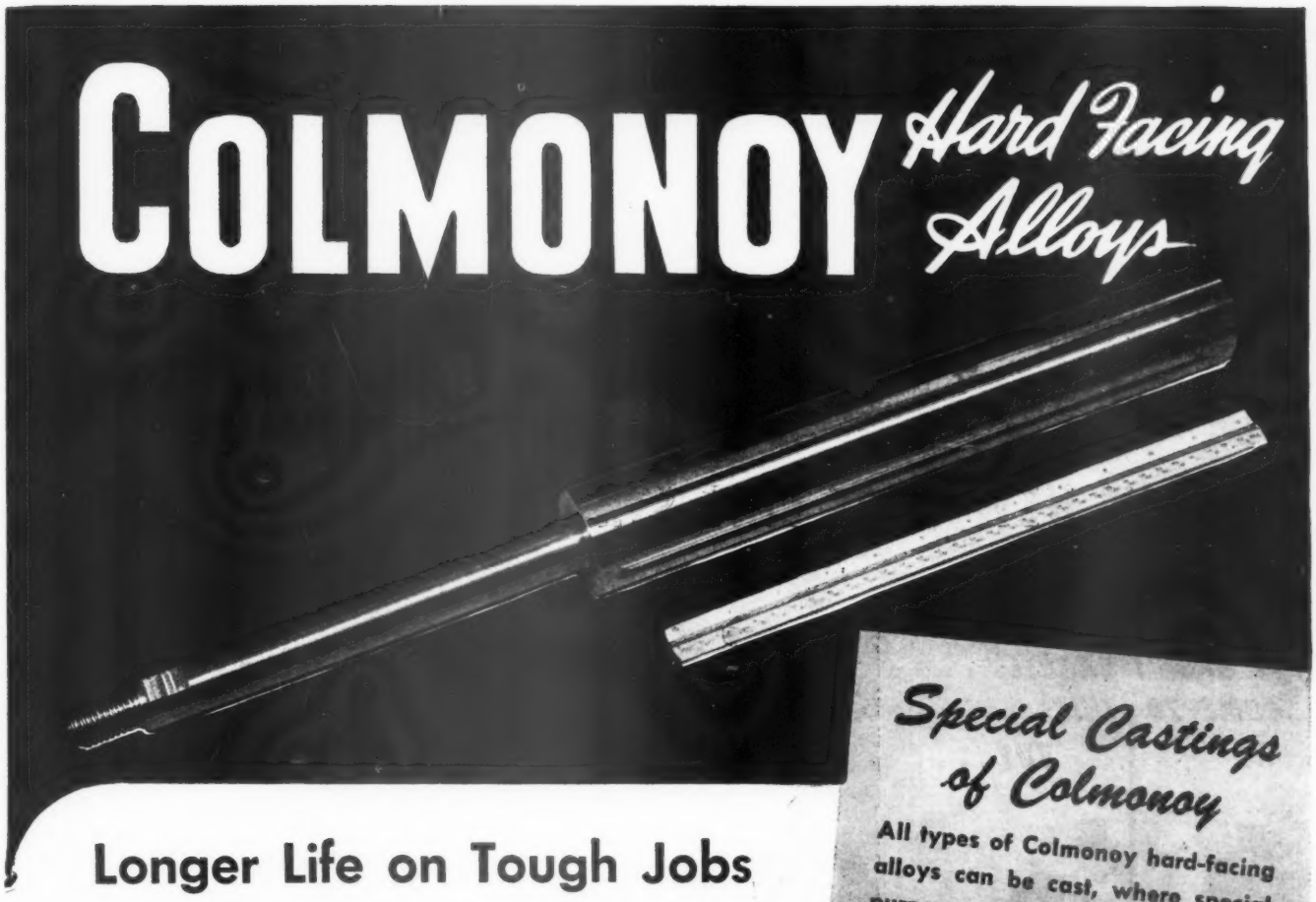
The corporation, one of the nation's largest manufacturers of dehumidification equipment, reveals its decision to speed production of improved breathers is based on sharply increased demands for breather attachments.

Officials of the Pittsburgh firm trace the increased demand for breathers to current difficulties in replacing corroded and outworn chemical and oil storage tanks, plus

Two models of breather line.



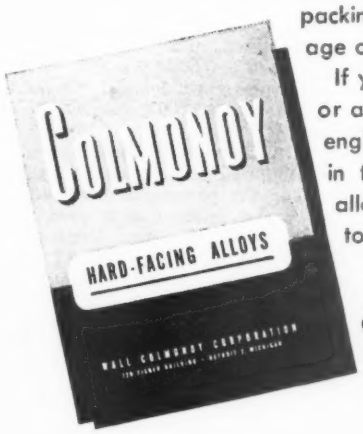
COLMONOY *Hard Facing Alloys*



Longer Life on Tough Jobs

These plungers are used in a nationally known refinery down Oklahoma way, in a pump handling 37,850 pounds of 98% sulphuric acid a day, at 70° F. The practice is to regrind after one year's operation and replace after two years. The wear averages only .0010" per year.

Many enthusiastic users say Colmonoy is the best metal available for combating the corrosion caused by acids and other chemicals. One plant superintendent writes, "The Colmonoy pump shaft is still in continuous service after two years, has used much less packing and has caused no trouble whatsoever, as compared to former continual repacking and replacement on an average of every six months."



If you have a problem in corrosion or abrasion resistance, Colmonoy engineers have a long experience in the application of hard-facing alloys that can be of great benefit to you.

Write for Catalog

Covers the entire line of Colmonoy hard-facing alloys and illustrates typical applications.

Special Castings of Colmonoy

All types of Colmonoy hard-facing alloys can be cast, where special purposes make this desirable. Colmonoy castings are made to close tolerances to minimize grinding and finishing operations.

Send your blueprints, specifications and service conditions for recommendation and quotation.

Fabricated Job Work

In our many branches throughout the United States and Canada we maintain our own plants, in charge of capable engineers. These facilities are available for jobbing work involving hard-facing and related problems. Write for address of office nearest you, and send prints.

WALL COLMONOY CORPORATION

7TH FLOOR FISHER BLDG., DETROIT 2, MICH.

the necessity of protecting the contents of such tanks against pollution and spoilage by atmospheric moisture.

Breathers in production at Pittsburgh Lectrodryer carry the trade name of Lectrobreathers and can either be mounted directly over a tank's vent or be piped to it. Incoming air is thoroughly dried by its passage through activated aluminas contained in the breather. The air exhaled by the tank equipped with a Lectrodryer is dry. It has a partial reactivating effect, thus making possible long periods between reactivations of the breather. The breathers are equipped with a color indicator for determining when they are in need of reactivation and when reactivation is complete.

G. L. Simpson, vice president and general manager of the Lectrodryer organization, points out that it has long been generally known that storage tanks are in effect giant lungs, inhaling air as temperatures drop or the tanks are emptied and expelling air as temperatures rise or the tanks are filled.

Moisture carried into the tanks in the breathing process pollutes the tanks' contents and acts as a corrosive agent on the tanks themselves. Atmospheric moisture pollution of a tank's contents in many cases renders the contents useless and in some cases even dangerous. It may also adversely affect their later processing.

Despite these facts, many firms employing tanks have until recently been content to "write off" losses sustained by moisture pollution—particularly in pre-war days when chemicals, oils, and new tanks were readily and cheaply replaced, Simpson says. Today, however, the picture is rapidly changing. Aware of the fact that storage tanks can't be stopped from breathing, those who employ tanks in their business are using more and more breathers to preserve tanks and contents.

Although manufacturers of dehumidification equipment generally produce breathers in several standardized sizes, Simpson advises that several factors be considered before any specific size or type is installed. These factors are: (1) How frequently and how fast a tank is emptied; (2) how many cubic feet the tank contains, (3) the nature of the tank's contents, and (4) weather conditions.

(12) *Electronic tachometer*

A new electronic tachometer designed for measuring rotating speeds from 300 to 50,000 r.p.m. has been announced by the Special Products Division of the General Electric Company. Weighing only 19 lb., the new tachometer is useful for the production testing of equipment instantaneously without the necessity for any permanent attachments. It can be used to indicate the speeds of electric motors, machine tools, automotive and aircraft engines, pumps, fans, blowers, and other types of rotating equipment.

The electronic tachometer consists of a small pick-up head, 6 ft. of flexible cable, and a measuring unit with a panel-mounted

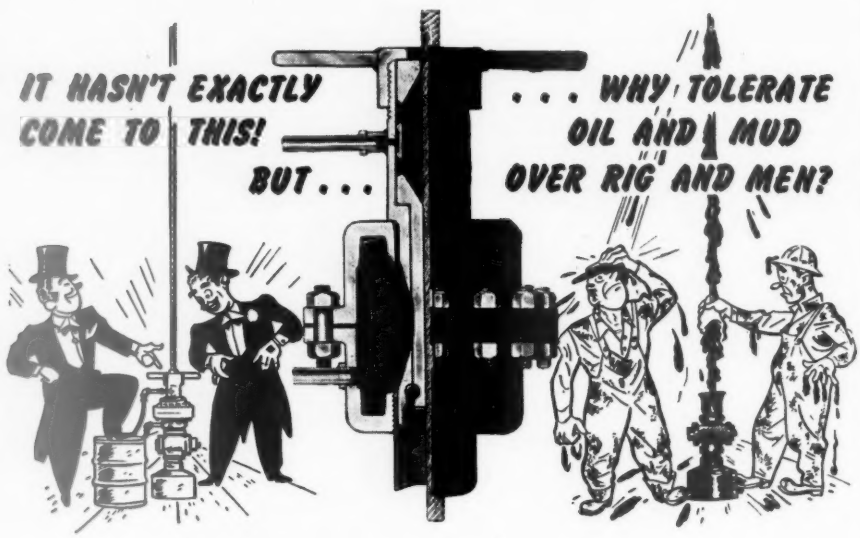
indicating instrument reading directly in r.p.m. Either a low-speed or high-speed head can be used with the instrument. The low-speed head provides five speed ranges, 0-1000, 0-2000, 0-5000, 0-10,000, and 0-20,000, and the high-speed head provides three speed ranges, 0-10,000, 0-20,000 and 0-50,000 r.p.m.

Each pick-up head consists of a light-interrupting disk and a phototube. Light shining upon the phototube through the openings in the rotating disk produces input signals that are then transferred to the measuring unit, which indicates the r.p.m. of the equipment being tested. The shaft to which the disk is attached rotates on ball bearings and requires very little torque, and therefore the speed of the equipment being measured is not reduced by use of the tachometer.

(13) *Econo-gauge*

The manufacturer of the new "Econo-Gauge," Oil Equipment, Inc., has engineered a simple dependable way to show the liquid level of storage tanks in feet and inches on a dial mounted conveniently alongside the tank. It can be used with all types of storage tanks, for gasoline, oils, chemicals, and other liquids, it is stated.

REGAN'S NEW WIRE LINE STRIPPER

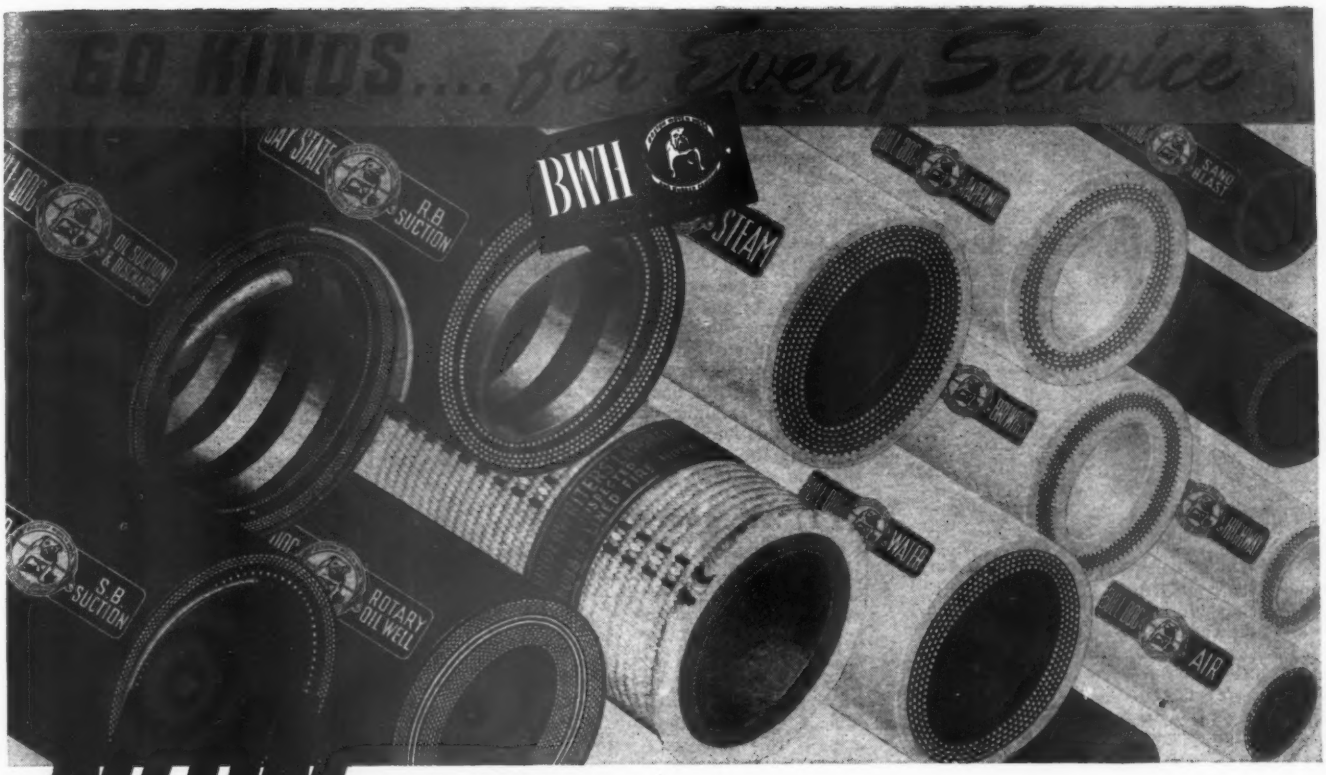


Regan's New Wire Line Stripper Really Wipes Lines Clean

WRITE FOR NEW BULLETIN

Regan Forge & Engineering Co.
Quality
SAN PEDRO, CALIFORNIA, U. S. A.
HOUSTON, TEXAS

EXPORT DISTRIBUTOR: 19 Rector Street, New York City, N.Y. Avda Pte. R. Saenz Pena 832, Buenos Aires, Argentina. P.O. Box 2125, Houston, Texas



NOW.... MORE COMPLETE STOCKS

For twenty-seven years, we have supplied Boston Woven Hose Products to operators throughout the Mid-Continent area. Belting and Hose of highest quality have earned for the Boston Woven Hose and Rubber Company and ourselves a reputation for economical and dependable service.

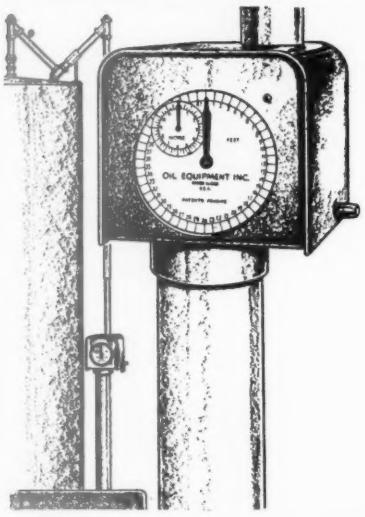
Now, a more complete stock of BWH Hose is available through our stores in Oklahoma, Arkansas, Illinois, Kansas and Texas. We appreciate this opportunity to offer better service to our valued customers.

Happy Coolers
Rubber Belting
Leather Belting
V Belts
V Belt Sheaves
Happy Pumping Units
Power Transmission Equipment

The **HAPPY COMPANY**
Formerly **HAPPY BELTING COMPANY**
TULSA, OKLAHOMA

BRANCH OFFICES:

Seminole	Oklahoma
Smackover	Arkansas
Odessa	Texas
Kilgore	Texas
Pampa	Texas
Wichita Falls	Texas
Salem	Illinois
Wichita	Kansas
Ellinwood	Kansas



The Econo-Gauge has a minimum of working parts. By means of a specially designed float inside the tank and a counterweighted cable, the position, or movement, of the float or the rise and fall of the liquid level, is transmitted to a grooved drum that in turn, as it revolves, actuates the dial recording mechanism. The manufacturer asserts that this will indicate the slightest change in liquid level with no chance of error.

A feature of the Econo-Gauge is that it can be installed with a liquid seal at top to prevent evaporation of gasoline or similar volatile liquids. Such a vapor-tight installation will withstand up to 28 oz. of pressure.

The specially designed weighted buoyant float used in the Econo-Gauge contributes much to its accuracy. "Swirl" and movement of the float caused by the turbulence of loading or unloading, or currents resulting from temperature changes, are minimized.

The gauge proper is housed in a heavy steel case that can easily be raised, exposing all the working parts. Adequate ventilation prevents the transparent non-breakable dial from "clouding." The case is held in position by a heavy slotted pin, and with a simple padlock through this slot can be made completely tamper-proof. A simple expansion joint made as a part of the gauge case takes care of any tank sway without affecting the gauge installation.

All parts of the Econo-Gauge are properly treated and finished to resist corrosion. The cable is of the finest stainless steel. The entire unit is light in weight and easily handled for quick installation without even emptying the tank. The case proper is finished in a durable bright red enamel.

(14) *Air guard tube*

Development of an automobile inner tube of waffle-like construction, designed to prevent rapid deflation in the event of a puncture, is announced by the United States Rubber Company.

The crown of the new tube is composed of a patchwork of square pockets, which press against the inside of the tire as the tube is inflated. If the tube is punctured by a nail, this squeezing action crowds the rubber around the nail. Thus the tube loses air at a much slower rate, allowing the driver to proceed a greater distance before stopping for repairs.

The new product, known as the U. S. Royal Air Guard tube, will be marketed at premium prices when OPA price approval is given, reported W. D. Baldwin, sales manager of the company's U. S. Tires division.

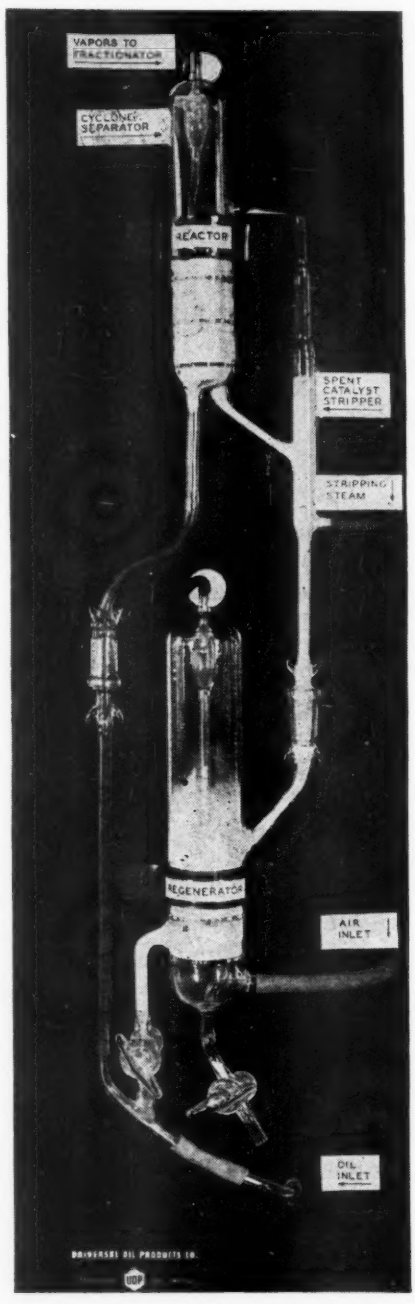
Butyl rubber, which retains air better than natural rubber, will be used in the manufacture of the tube, he said.

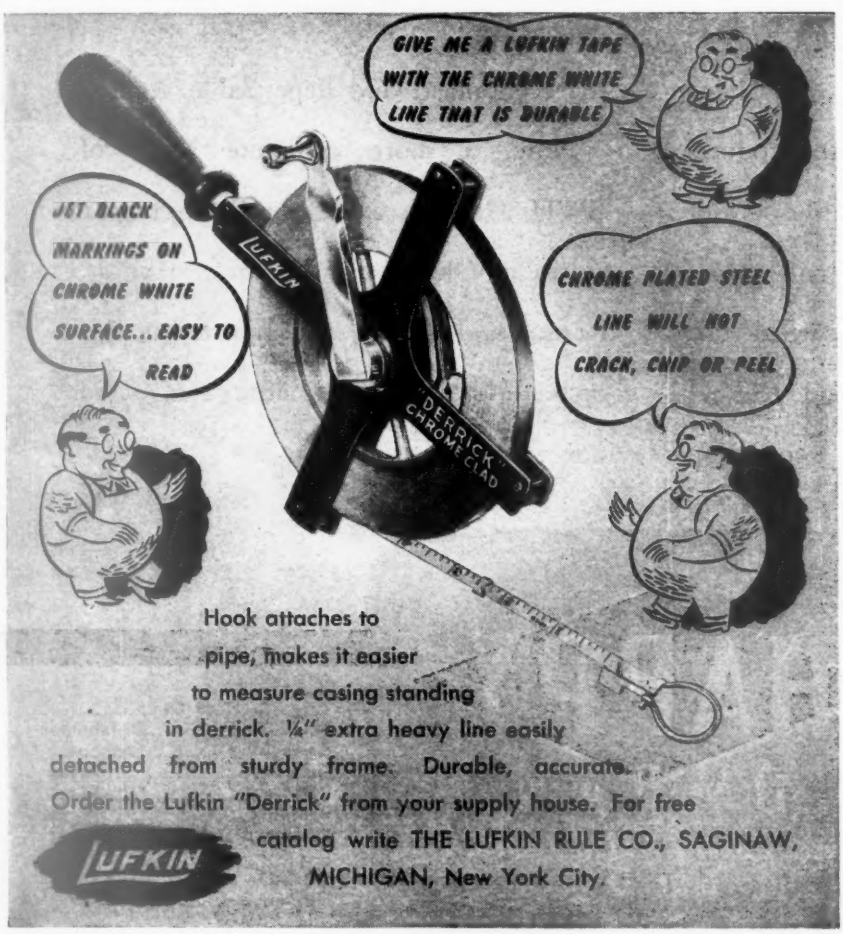
(15) *U. O. P. cracking unit*

The accompanying photograph shows a working model of the U.O.P. improved fluid catalytic cracking unit, which currently is attracting great interest in the refining industry.

Embodying important economies in design, the commercial unit that this model represents can be installed and operated at markedly lower cost than the large units used during the war to produce 100-octane aviation gasoline, U.O.P. officials state. Thus, the advantages of catalytic cracking are placed within the reach of refiners having plants of small capacity.

In the working model, air is substituted for oil vapor as a medium for transporting catalyst from the regenerator to the reactor. The circulation of catalyst between reactor and regenerator is seen through the glass walls.




GIVE ME A LUFKIN TAPE WITH THE CHROME WHITE LINE THAT IS DURABLE
JET BLACK MARKINGS ON CHROME WHITE SURFACE... EASY TO READ
CHROME PLATED STEEL LINE WILL NOT CRACK, CHIP OR PEEL
LUFKIN
DERRICK CHROME CLAD
Hook attaches to pipe, makes it easier to measure casing standing in derrick. ¼" extra heavy line easily detached from sturdy frame. Durable, accurate. Order the Lufkin "Derrick" from your supply house. For free catalog write THE LUFKIN RULE CO., SAGINAW, MICHIGAN, New York City.
LUFKIN

Everything in Refinery Piping from One Complete Line

Now—when you're converting, refitting, or building new units—count on the Crane line to help you speed all piping jobs and insure efficient operation.

Plan now to get all the benefits of standardization that Crane makes possible by supplying everything in steel, brass, and iron piping materials for modern refinery methods. From design to erection to maintenance—let the 3-way advantage of standardizing on Crane equipment simplify every step of piping procedures:

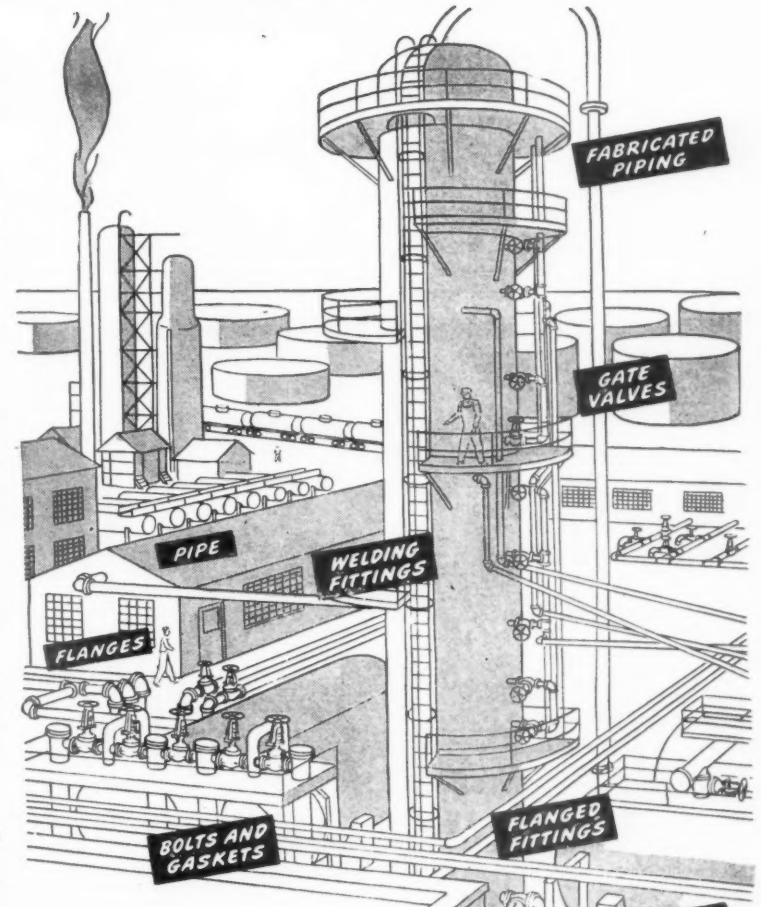
ONE

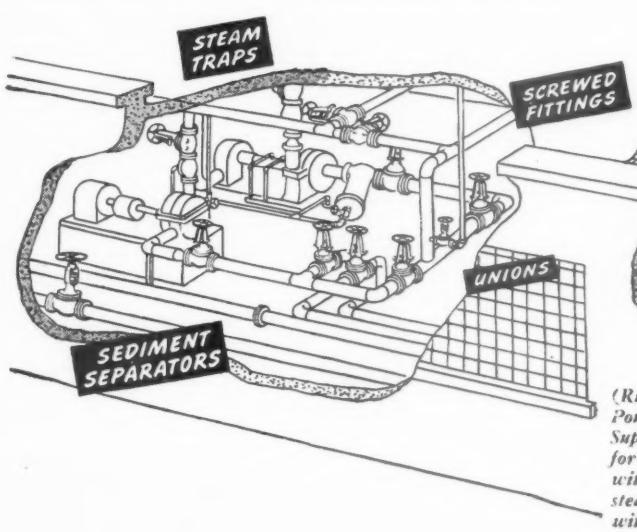
ONE SOURCE OF SUPPLY—giving you the world's most complete selection of valves, fittings, pipe, accessories and fabricated piping for all power, process, and general service applications.

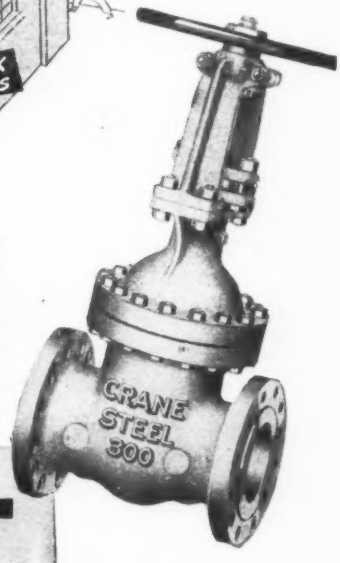
ONE RESPONSIBILITY for all piping materials—always helping you get the best installation, and avoiding needless delays.

ONE STANDARD OF QUALITY in every item—quality that keeps winning new friends for Crane—assuring uniform dependability and durability throughout piping systems.

The best way to stabilize piping costs . . . Standardize on Crane equipment! Crane Co., *General Offices:* 836 S. Michigan Ave., Chicago 5, Ill. *Branches and Wholesalers in All Industrial Areas.*







(Right) **FIT FOR THE JOB**—*Crane 300-Pound Alloy Steel Wedge Gate Valves. Supplied with Exelloy to Exelloy seating for oil and oil vapor services up to 1100° F.; with Exelloy to No. 49 Nickel Alloy for steam, water, gas, or air up to 850 °F.; and with Stellite to Stellite for steam up to 1000° F. Screwed, flanged, or welding ends. Complete specifications in your Crane Catalog.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
HEATING • PUMPS

CRANE

FOR EVERY PIPING SYSTEM

(16) *Block and hook; kelly*

The Guiberson Corporation's new unitized block and hook is of a compact and streamlined design, being only 48 in. in overall height, 10 in. thick, and 25 in. wide. It has a conservatively rated capacity of 45 tons and is available with one or two 24 in. dia. sheaves.

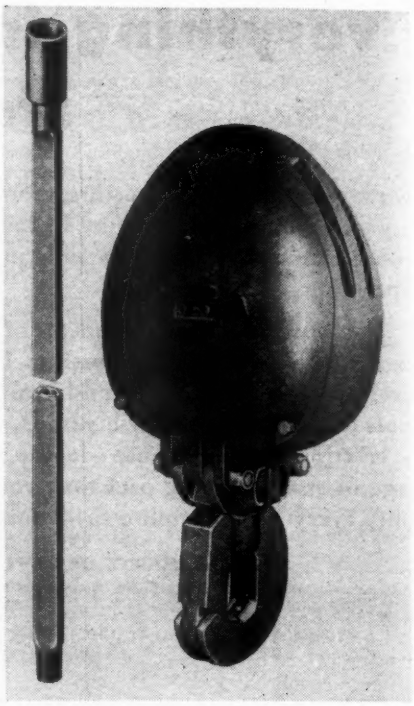
The quick-opening design permits lines to be reeved without disconnecting the hook, by simply opening the block through removal of the guards and one pin.

The load is carried in perfect balance, avoiding off-center strains, it is stated. The symmetrical streamlined body has no protruding bolts or sections to hang up or cause injuries.

The hook may either swivel or be locked in any one of eight positions. The hook link carries a proportional part of the load, eliminating flexing and fatiguing of the hook, under repeated heavy loads. The hook link is securely locked when closed.

The new Guiberson Ful-Flo kelly offers many advantages for use on well completions, clean-out work, exploratory and light portable rigs. The kelly is built on a new principle to meet the severest requirements of rotating and supporting the string as well as supplying full flow circulation.

The Ful-Flo kelly has an inner core of seamless thick-walled tubing inside a tight fitting outer shell of square cold-drawn steel. The inner core and outer shell are securely bonded together to form a one-piece unit. This construction combines great resistance to bending, light weight, added circulation area, and a true bore throughout its length.



This kelly feeds smoothly through the kelly bushing as it has great stability and does not whip or gyrate in operation due to its perfect balance.

Final inspection includes 3000 lb. per sq. in. hydrostatic test.

The Ful-Flo kelly is available in 2½ in. and 3 in. sizes. The top connection is 3½ in. L.H. female drill pipe thread for both sizes. The 2½-in. size has a male 2-in. external upset tubing 8-thread bottom connection and is available in 18½-ft. overall length. The 3-in. kelly is 21½ ft. long and has a male 2½-in. tubing 8-thread bottom connection.

(17) *Homogenizer*

Intensive tests in the laboratory and field conducted by Marco Company, Inc., of Wilmington, Delaware, indicate that much can be accomplished by processing greases and blending oils with Flow-master equipment.

Flow-master Homogenizers and Kom-bi-nators are a distinct departure from convention in both design and performance, the manufacturer states. Pressure is only one of several actions to which products are subjected in continuous operation—each bringing the product one step nearer perfection until the desired result is achieved.

In the production of lubricating greases, the Flow-master Kom-bi-nator combines the functions of an homogenizer and a colloid mill. The various oils, soap stock and additives entering the machine first pass through a compounding chamber where the components are uniformly combined. They are then forced forward along the shaft between the rotor and stators where the milling action takes place. The oils are uniformly dispensed to produce a grease of very superior quality, it is asserted.

To obtain continuous production of either blended oils or greases, it is only necessary that a Flow-master pump be connected to each of the oil and stock supply tanks, it is stated. By equipping each pump with a variable speed drive, the exact amount of each component can be accurately proportioned and pumped through a main line directly into the intake port of either the Homogenizer or Kom-bi-nator.

Reilly

PROTECTIVE COATINGS

FOR WOOD, METAL, BRICK, CONCRETE STONE AND TILE SURFACES

● REILLY PIPE ENAMEL
For coating oil, gas, and gasoline pipe lines, water conduits, and as a lining for steel water and storage tanks, whether mobile or stationary, underground or elevated.

● REILLY COLD APPLICATION No. 40
For tanks, structural steel and other metal surfaces exposed to the atmosphere and to corrosive gases.

● REILLY COLD APPLICATION No. 5
For tanks and other metal designed for underground or underwater service. Also an excellent water-proofing agent for concrete.

● REILLY COLD APPLICATION No. 50
For metal, tile, stone and concrete surfaces that are subject to erosion, corrosion, or the action of either fresh or salt water.

● REILLY BITUMINOUS PIPE DIP COMPOUND
For hot-dipping cast iron pipe and fittings.

● REILLY RESISCOTE
A corrosion-resisting paint, available in colors. For use on internal combustion engines, steel pickling houses, water works and sewage plants.

● REILLY CREOCOTE
For painting creosoted wood block floors, poles, guard rails, posts and other creosoted surfaces. (Available in colors.)

● REILLY ALUMINUM COATING
One coat gives dependable protection and beauty to metal, cement, brick, tile and wood surfaces. Heat-resisting, surface protecting, beautifying.

● REILLY TRANSOTE
A transparent, stainless wood preservative that stops insect and fungi attacks and prevents their recurrence. Wood treated with Transote can be painted, varnished, glued or finished in any desired manner. Applied by dip, spray or pressure methods.

These coatings are fully described in a 20-page booklet which will be sent on request.

REILLY TAR & CHEMICAL CORPORATION
Merchants Bank Bldg. • Indianapolis 4, Indiana
500 Fifth Ave., New York 18, N.Y.
2513 S. Damen Ave., Chicago 8, Illinois

LOOK TO GEMCO

FOR THE FINEST IN MODERN CATHEAD EQUIPMENT

GEMCO Friction Type Catheads are strong — powerful — compact — truly an outstanding forward step in Cathead design.

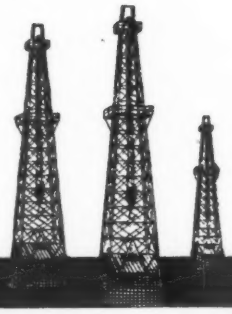
A single GEMCO Cathead is quickly, easily converted from Spinner to Breakout—shifting from one side to the other in less than 10 minutes; without disturbing shaft mounting, anchor, or operating control.

It has amazingly smooth performance; a result of fine engineering. The Internal Expansion Clutch takes hold with a smooth, steady grip that easily transmits sufficient power to break the toughest joints.

GEMCO Catheads are economical to operate. The Clutch requires no adjustments. The speedy side-to-side switch prevents long delays. No shut-downs for repairs when you use the GEMCO Cathead.

• • •

AVAILABLE WITH GIANT 16-IN. REGULAR OR COOLED SPOOL AT SMALL EXTRA COST



CONSULT YOUR DRAWWORKS MANUFACTURER, SUPPLY STORE, OR WRITE US DIRECT

GEMCO OIL TOOLS

INCORPORATED

4417 OLEATHA AVE. • ST. LOUIS 16, MO., U.S.A.

MODERN EQUIPMENT FOR THE OIL WELL DRILLING INDUSTRY

TRADE LITERATURE

Publications listed are sent free upon request.

(18) *Lubricated mechanical seal*

A new bulletin issued by Durametallic Corporation, Kalamazoo, Michigan, illustrates and describes an application of the company's Dura Seal (rotary mechanical seal). The use of a single Dura Seal combined with a mechanical positive force-feed lubricator provides highly satisfactory sealing for hydrocarbons, boiler feed water, crude oil, petroleum products, and other liquids and fuels, according to officials of the company.

(19) *Silicone diffusion pump fluids*

Dow Corning Corporation Silicone fluids for use in high vacuum diffusion pumps, designated as DC 702 and DC 703, are discussed in a new bulletin.

(20) *Fluor general catalog*

The Fluor Corporation, Ltd., 2500 South Atlantic Boulevard, Los Angeles, California, has recently published its General Catalog No. 46, which contains information on all Fluor manufactured products, plus a description of the engineering and construction services offered by the firm. The Fluor Corporation, Ltd., manufactures equipment for the oil, gas, and allied industries, and also serves as designers, engineers, and constructors in these same fields.

The Fluor Corporation, Ltd., 2500 South Atlantic Boulevard, Los Angeles, California, has recently published its General Catalog No. 46, which contains information on all Fluor manufactured products, plus a description of the engineering and construction services offered by the firm. The Fluor Corporation, Ltd., manufactures equipment for the oil, gas, and allied industries, and also serves as designers, engineers, and constructors in these same fields.

(21) *Uniform wire rope terms*

There is a trend on the part of the wire rope industry and the Federal Bureau of Standards to unify and adopt common terminology. Federal specifications have adopted these terms and have taken a leading part in using them. In cooperation with this effort, Macwhyte Company, Kenosha, Wisconsin, is also adopting these terms and they will appear in the revised reprint of the company's G-15 Catalog and new price lists now being printed.

(22) *Scale drawing pad*

Jiffy Sketch is the name of a scale drawing pad that is being introduced by Jiffy Sales Company, Cleveland, Ohio. It enables one to make properly proportioned drawings without use of ruler, drafting board or T-square, and it may be used in the shop or in the field as easily as in the office.

The Jiffy Sketch pad contains 75 sheets of high quality tracing tissue, enclosed within a cover jacket that consists of four cardboard flaps. Various scales are printed on three of the flaps. To use the pad, simply fold back the cover flap and then place one of the tissue sheets over the scale you wish to employ. The drawing is made accurately to scale with the aid of the printed lines that show through the tissue.

(23) *Pipe and fitting materials chart*

Engineers, draftsmen, purchasing agents, and others concerned with the buying, design, layout, and erection of piping systems will welcome the handy new "Chart of Pipe and Fitting Materials," recently issued by Tube Turns, Louisville, Kentucky. It deals with carbon, intermediate alloy, stainless and special analysis steels, and covers ASTM specifications, chemistry, service limitations, and welding procedure. The 9-in. by 14-in. chart folds to 8½-in. by 11-in. and fits easily into a standard letter-size filing cabinet; or it may be kept in a ring binder. For the latter use, it has convenient ring holes and a 7½-in. gate fold.

(24) *Pump valve service catalog*

Designed to illustrate the application of Durabla valve units for reciprocating pumps and diesel engines, Durabla Catalog No. 920, "Pump Valve Service" has been published by Durabla Manufacturing Company, 114 Liberty Street, New York, New York.

The applications illustrated in this catalog are primarily on pumps and diesel engines that use Durabla valve units as standard equipment, but the details presented not only provide a summary of the design characteristics of Durabla valves but also indicate their adaptability for use as replacement units on any type of reciprocating pump.

(25) *Vertical centrifugal pumps*

A new 6-page bulletin has been issued that describes the design, construction, and application of three types of Peerless vertical centrifugal pumps for general purpose pumping in a wide variety of industrial services such as sump and drainage pumping, general water supply, mine station service, cooling tower service, etc. The Peerless vertical centrifugal water pump line, includes both submerged and close-coupled types, the submerged types being supplied either with top or bottom suction. Each of these types is adapted to all forms of power drive, including direct-connected electric, right angle gear, and belt (V or flat) as well as combinations of these forms. In general all three types develop capacities from 200 to 5000 gal. per min. and will pump against heads from 20 to 100 ft.

(26) *Fluid catalytic cracking*

The economic significance of the fluid catalytic-cracking process of oil refining as improved since the war to its present most advanced state, is considered in a new brochure, "Fluid Progress," published by The M. W. Kellogg Company, petroleum engineers, of Jersey City, New Jersey, and New York, New York.

The brochure describes the major improvements made in basic design since the end of the war. These advantages, which simplify the unit, resulting in lower investment costs and higher operating efficiency, include reduced elevation of the structure, by which less steel is required for construction, and improvements in design, which increase the recovery of catalyst and oil vapors.

With the present keen interest in the problems of the operators of small refinery units, special attention centers on the application of the fluid process to small units. The brochure points out that the method now is economically applicable to virtually all size installations.

(27) *The vaporsphere*

The Chicago Bridge and Iron Company, Chicago, Illinois, announces the publication of a new 20-page booklet, "The Vaporsphere." It describes the method of reducing evaporation losses from flat-bottom tanks storing volatile liquids by installing a vapor-saving system with facilities for the temporary storage of vapor.

The method for determining the correct size of the Vaporsphere, which is used for the temporary storage of the vapor, is discussed together with the method of designing the vapor lines that connect the flat-bottom tanks to the Vaporsphere. The vapor pressure, expansion of air-vapor mixture, and the flow of vapor in the lines can be read directly from charts included in the booklet.

(28) *Worthington bulletins*

Three bulletins recently have been published by Worthington Pump and Machinery Corporation, Harrison, New Jersey.

Bulletin No. WP-1099-B50 describes the Worthington "package type" steam turbine generator power plant. This plant provides an electrical generating station having features of portability, compactness, simplicity of design and operation, rapidity of assembly and disassembly, and adaptability to a wide range of climatic conditions and variations of fuel and water supply, it is stated.

Bulletin W-350-B5A is on Worthite specialties, which include valves, pipe, flanges, hose nipples, castings, bars, forgings, wire, welding electrodes, and screw machine products.

Worthington HB single horizontal air and gas compressors are the subject of Bulletin L-640-B1A.

(29) *Foxboro Model 40 controller*

Bulletin 381, now being distributed by The Foxboro Company, Foxboro, Massachusetts, describes the Model 40 controller, the newest addition to the company's line of instruments for process control. Large illustrations, accompanied by appropriate text, explain the many features of design that make the Model 40 virtually a wholly new instrument in design and construction.

The operating-panel feature of "Stabilog" control instruments is shown, and the convenience of operation of maintenance of the Model 40, achieved through unit construction and assembly, is well illustrated. Indicating models, as well as single- and multiple-pen recorders are shown, and the five types of control action available in the Model 40 are explained.

(30) *Waukesha engines*

Waukesha Motor Company, Waukesha, Wisconsin, in recognition of 40 years' internal-combustion manufacture, has issued a new bulletin. This publication tells of the growth of the company and discusses its equipment lines.

(31) *Water tube boiler*

Henry Vogt Machine Company, Louisville, Kentucky, has issued a new bulletin covering the Vogt Class VL water tube boiler. The basic design of the boiler permits its adaptation to limited space conditions when necessary, in industrial plants, etc., having diverse steam requirements.

THE *Petroleum* Engineer's CONTINUOUS TABLES

A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT No. 112

A VALUABLE and regular feature of *The Petroleum Engineer*, the Continuous Tables, now in their tenth year of publication, were designed to save time and effort for the technician and the practical field or plant worker. The tables have proved one of the most popular and helpful departments of *The Petroleum Engineer*. Data are presented in the simplest form available with many types of information included that are best presented by curves or nomographs when three or more variables must be considered simultaneously.

The Continuous Tables have developed as a result of suggestions for new tables, direct contributions and improvements to existing tables by members of the petroleum and related industries, including manufacturing concerns, who are continually searching for practical information reduced by computation to tabular form readily applicable to the problems daily confronting them that might otherwise necessitate a more or less tedious calculation. These contributions and suggestions from the industry have resulted in a valuable exchange of information and data contributing to the progress of the industry as a whole.

This index will be revised monthly. The index for installments 1-12, inclusive, will be found in the May, 1938, issue; 13-24, inclusive, in the June, 1939, issue; 25-36, inclusive, in the June, 1940, issue; 37-48, inclusive, in the June, 1941, issue; 48-60, inclusive, in the June, 1942, issue; 61-72, inclusive, in the June, 1943, issue; 73-79, inclusive, in the January, 1944, issue; 80-82, inclusive, in the April, 1944, issue; 83-85, inclusive, in the July, 1944, issue; 86-88, inclusive, in the October, 1944, issue; 89-91, inclusive, in the January, 1945, issue; 92-94, inclusive, in the April, 1945, issue; 95-97, inclusive, in the July, 1945, issue; 98-100, inclusive, in the October, 1945, issue; 101-103, inclusive, in the January, 1946, issue; 104-106, inclusive, in the April, 1946, issue; 107-109, inclusive, in the July, 1946, issue.

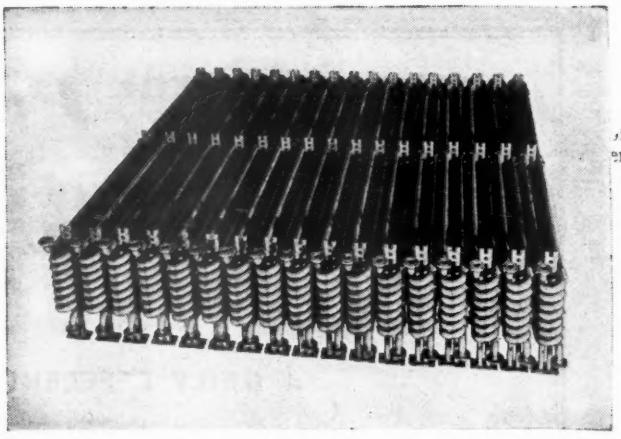
INDEX TO TABLES

		Index No.	*Page*	*Issue*
Chart for estimating horsepower for hoisting		P 404.	257	Oct.
Capacity of mud pit, cu. ft. per in. depth	(sheet 3)	P 425.218.21	205	Aug.
Capacity of mud pit, bbl. (42 gal.) per in. depth	(sheet A)	P 425.218.21	223	Sept.
Capacity of mud pit, bbl. (42 gal.) per in. depth	(sheet B)	P 425.218.21	225	Sept.
Pressure of various fluid columns in wells		P 425.250.	229	Sept.
Flow curve—bottom hole choke beans		P 511.222.	227	Sept.
Gas pipe line design factors	(sheet 1)	P 622.01	207	Aug.
Gas pipe line design factors	(sheet 2)	P 622.01	211	Aug.
Gas pipe line design factors	(sheet 3)	P 622.01	215	Aug.
Gas pipe line design factors	(sheet 4)	P 622.01	217	Aug.
Gas pipe line design factors	(sheet 5)	P 622.01	231	Sept.
Gas pipe line design factors	(sheet 6)	P 622.01	233	Sept.
Gas pipe line design factors	(sheet 7)	P 622.01	235	Sept.
Gas pipe line design factors	(sheet 8)	P 622.01	261	Oct.
Gas pipe line design factors	(sheet 9)	P 622.01	263	Oct.
Gas pipe line design factors	(sheet 10)	P 622.01	265	Oct.
Hydrate forming conditions for paraffin hydrocarbons		P 625.72	253	Oct.
Hydrocarbon thermodynamics	(sheet 14)	P 721.01	209	Aug.
Hydrocarbon thermodynamics	(sheet 15)	P 721.01	213	Aug.
Refrigeration data for gasoline plants		P 773.	259	Oct.
Cathodic protection chart for refineries		P 791.	255	Oct.

INDEX TO ADVERTISERS IN TABLES

		Page	*Issue*	*Backing Table No.*
Barrett Division, Allied Chemical & Dye Corporation	(sheet 9)	264	Oct.	P 622.01
Griscom-Russell Co.		254	Oct.	P 625.72
Hazard Wire Rope Division of American Chain & Cable Co., Inc.		258	Oct.	P 404.
Hyatt Bearings Division, General Motors Corp.		256	Oct.	P 791.
Linde Air Products Company	(sheet 10)	266	Oct.	P 622.01
Nash Engineering Co.		260	Oct.	P 773.
Toledo Pipe Threading Machine Co.	(sheet 8)	262	Oct.	P 622.01

Why it pays to bring tube problems to B & W



BABCOCK & WILCOX is a logical place for refineries and chemical plants to turn for sound, practical answers to all tubing problems—for a number of good reasons.

First, because so many *do* bring their tube questions here—and have for 35 years—B&W can answer yours in the light of exceptionally broad experience in supplying BOTH Seamless *and* Welded tubing for every purpose in refineries, synthetic rubber plants and other chemical processes.

And . . . this B&W experience embraces an exceptionally wide range of steel analyses, several of them available from no other source—from simple low carbons to high alloys that include, stainless and other corrosion-resistant steels, carbon-molybdenum steels and many special B&W Croloys.

B&W suggestions for matching tubes to jobs are impartial—based only on what tubing properties are best for each combination of corrosion, oxidation, heat resistance, creep strength and other conditions.

You can count, too, on B&W data being up-to-the-minute, for day in, day out, technicians in B&W's large, complete tube laboratories are constantly searching for still better alloys that will extend tube life, reduce maintenance, and increase tubing dependability and economy.

Make the expertly staffed B&W laboratory your "question and answer department" on any tube problems.

TA-1383

Other B&W Products

THE BABCOCK & WILCOX CO.

85 LIBERTY STREET • NEW YORK 6, N. Y.

Water-Tube Boilers, for Stationary Power Plants, for Marine Service • Water-Cooled Furnaces • Superheaters • Economizers • Air Heaters • Pulverized-Coal Equipment • Chain-Grate Stokers • Oil, Gas and Multi-fuel Burners • Refractories • Process Equipment.

BABCOCK & WILCOX SEAMLESS & WELDED TUBES

THE BABCOCK & WILCOX TUBE COMPANY

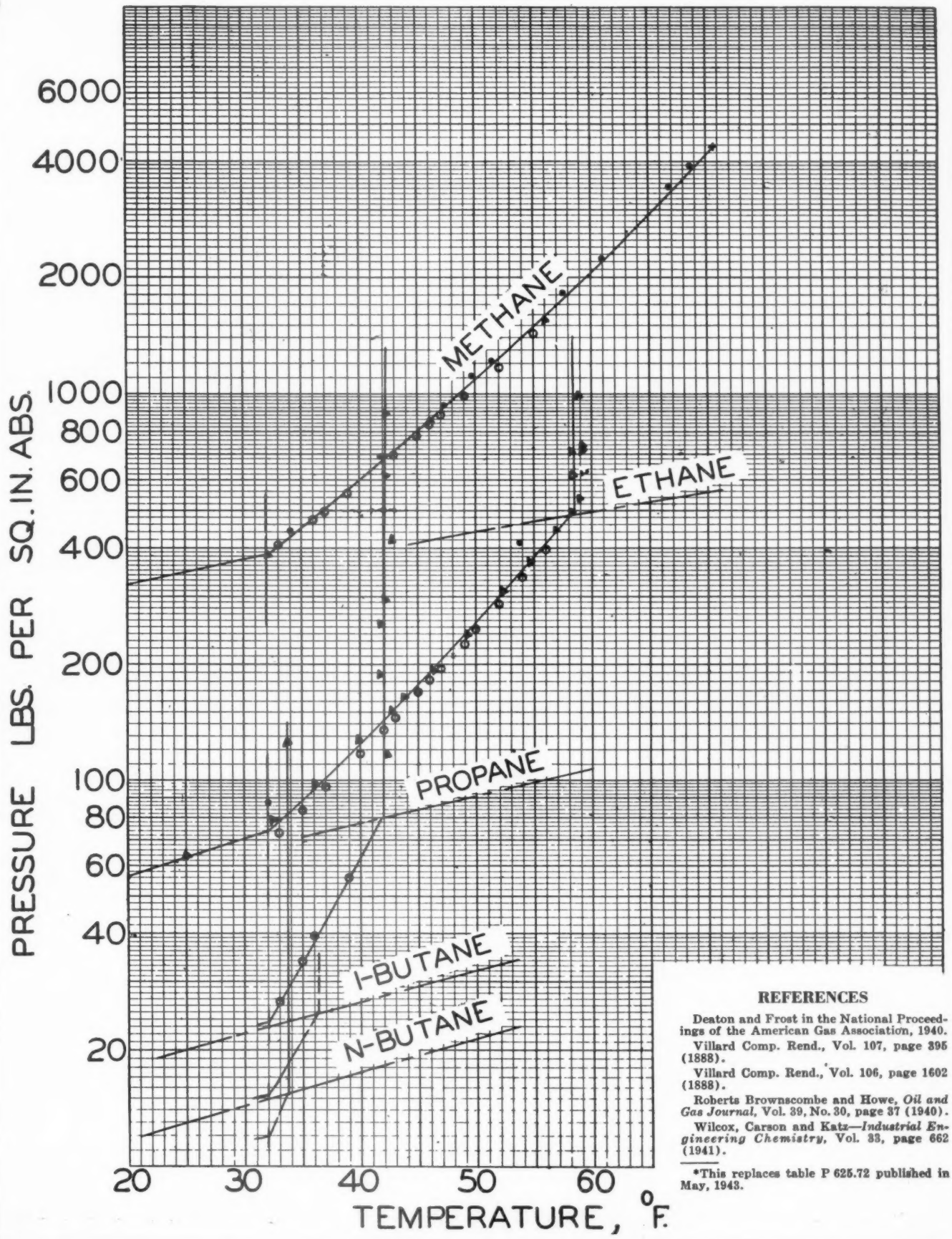
GENERAL OFFICES: BEAVER FALLS, PA.

PLANTS: ALLIANCE, OHIO AND BEAVER FALLS, PA.

P 625.72
*Revised

HYDRATE FORMING CONDITIONS FOR PARAFFIN HYDROCARBONS

—Chart by George Branger Brown, University of Michigan.



REFERENCES

Deaton and Frost in the National Proceedings of the American Gas Association, 1940.

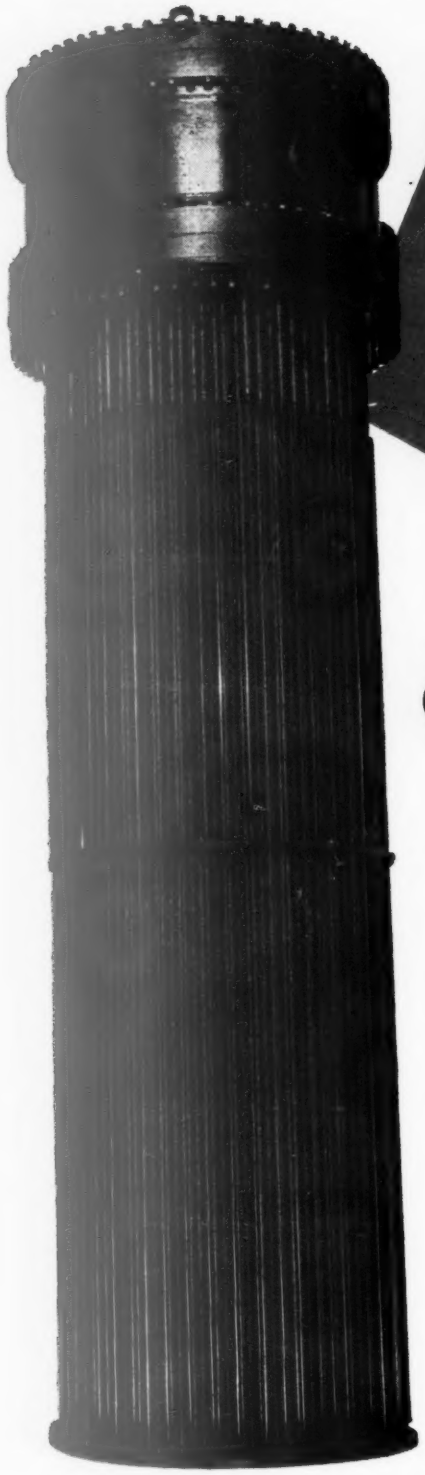
Villard Comp. Rend., Vol. 107, page 395 (1888).

Villard Comp. Rend., Vol. 106, page 1602 (1888).

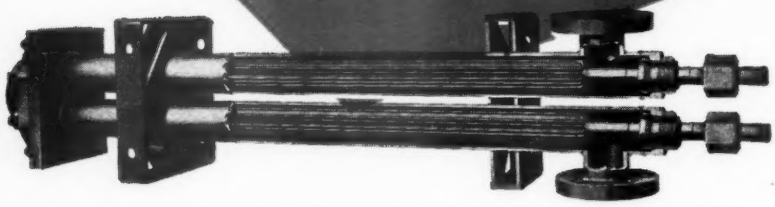
Roberts Brownscombe and Howe, *Oil and Gas Journal*, Vol. 39, No. 30, page 37 (1940).

Wilcox, Carson and Katz—*Industrial Engineering Chemistry*, Vol. 33, page 662 (1941).

*This replaces table P 625.72 published in May, 1943.



Why G-FIN is widely adaptable to many kinds of services fluids units



The G-FIN Element, originated 15 years ago by Griscom-Russell, has demonstrated the greatest range of usefulness of any heat transfer surface on the market.

These elements are used in more than 40,000 Twin G-Fin Sections serving as heaters, coolers, condensers and heat exchangers for a wide variety of liquids, vapors and gases. They are also extensively used in tank heaters, contactor bundles, and baffled units.

One reason for this unequalled adaptability of the G-Fin element is its longitudinal fins which provide six to eight times the external heat transfer surface of a bare tube. Another reason is that these elements can be applied to standard interchangeable sections which can be used for many different services. G-Fin elements have fully proven their dependability over long periods of service and under severe operating conditions.

The many uses of G-Fin units and their advantages of design and construction are more fully described in bulletins which will be sent on request.

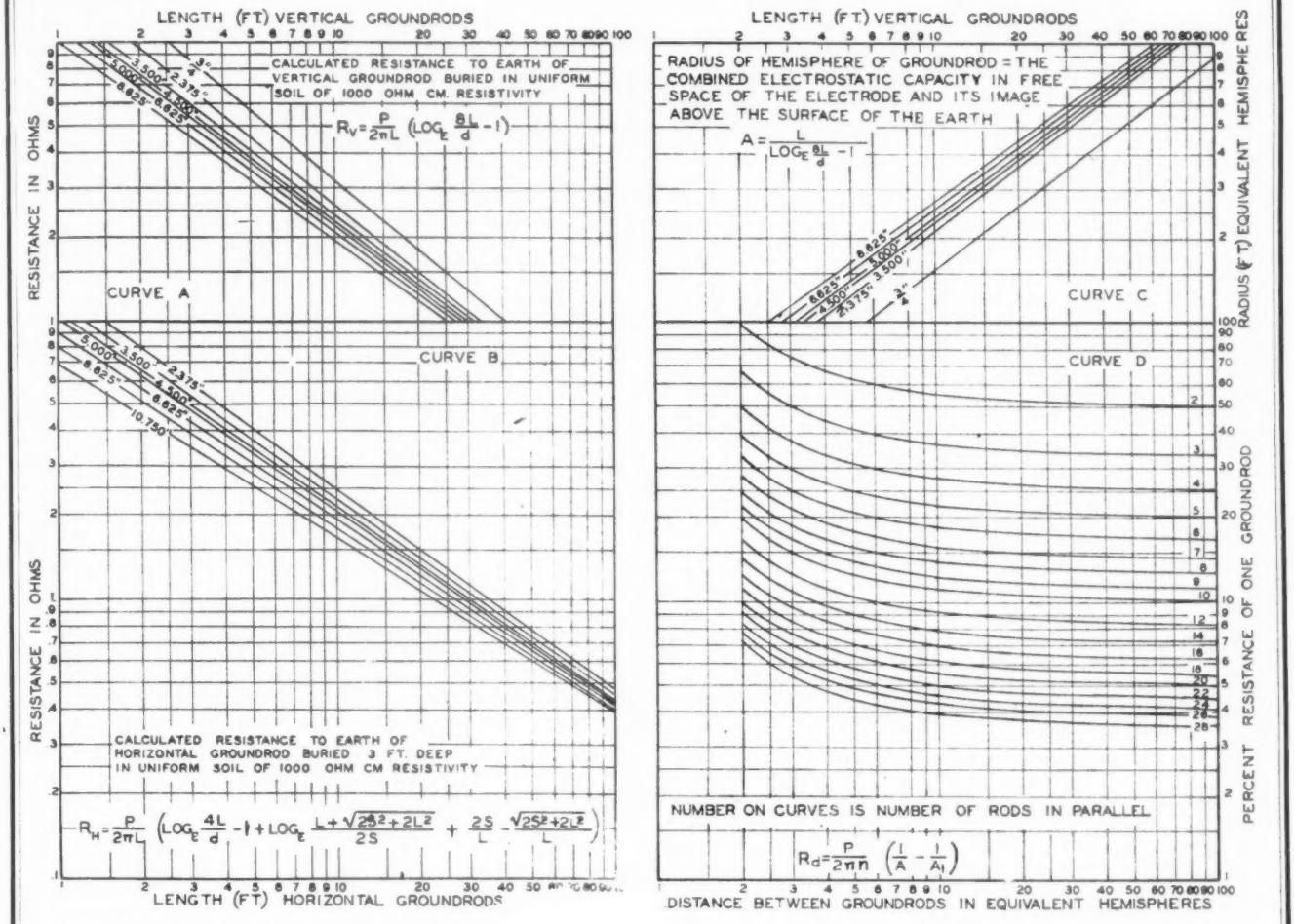
THE GRISCOM-RUSSELL CO., 285 Madison Avenue, New York 17, N. Y.

GR-120

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

CATHODIC PROTECTION CHART FOR REFINERIES


LENGTH (FT.) VERTICAL GROUNDRODS
CALCULATED RESISTANCE TO EARTH OF VERTICAL GROUNDROD BURIED IN UNIFORM SOIL OF 1000 OHM CM. RESISTIVITY
$R_V = \frac{P}{2\pi L}\left(\log_e \frac{8L}{d} - 1\right)$
CURVE A
CURVE B
RESISTANCE IN OHMS
CALCULATED RESISTANCE TO EARTH OF HORIZONTAL GROUNDROD BURIED 3 FT. DEEP IN UNIFORM SOIL OF 1000 OHM CM RESISTIVITY
$R_H = \frac{P}{2\pi L}\left(\log_e \frac{4L}{d} - 1 + \log_e \frac{L+\sqrt{2S^2+2L^2}}{2S} + \frac{2S}{L} - \frac{\sqrt{2S^2+2L^2}}{L}\right)$
LENGTH (FT) HORIZONTAL GROUNDRODS
LENGTH (FT.) VERTICAL GROUNDRODS
RADIUS OF HEMISPHERE OF GROUNDROD = THE COMBINED ELECTROSTATIC CAPACITY IN FREE SPACE OF THE ELECTRODE AND ITS IMAGE ABOVE THE SURFACE OF THE EARTH
$A = \frac{L}{\log_e \frac{8L}{d} - 1}$
CURVE C
CURVE D
NUMBER ON CURVES IS NUMBER OF RODS IN PARALLEL
$R_d = \frac{P}{2\pi n}\left(\frac{1}{A} - \frac{1}{A_1}\right)$
DISTANCE BETWEEN GROUNDRODS IN EQUIVALENT HEMISPHERES
RADIUS (FT) EQUIVALENT HEMISPHERES
PERCENT RESISTANCE OF ONE GROUNDROD

R_V = Resistance to earth of vertical groundrod.
R_H = Resistance to earth of horizontal groundrod.
R_d = Resistance in per cent of one vertical groundrod.
A = Radius of hemisphere of vertical groundrod.
A_1 = Distance from center of hemisphere to which R_V is computed.
P = Earth resistivity ohm cm.
L = Length of rod in cm.
d = Diameter of rod in cm.
S = Depth of horizontal rod in cm.
n = Number of rods in parallel.

—Equations by H. B. Dwight.

These curves are taken from the article entitled "Cathodic Protection in the Refinery," by D. Holsteyn, Shell Oil Co., Inc.. that was published in *The Petroleum Engineer* in May, 1946, pages 154 to 158, inclusive.

The resistance to ground may be manipulated by the length and the diameter of a groundrod as well as the number of groundrods and the spacing between them. The approximate economic balance of increasing the number of rods with a resulting saving in the cost of ground bed renewals is illustrated. The design of a cathodic unit often calls for 3 or 4 separate ground beds, totaling 30 to 40 groundrods and operating from one rectifier. The resistance to earth, with respect to each leg of the ground bed system, can be calculated from these graphs, so that no resistors are necessary for controlling the required current discharge to earth.

BIBLIOGRAPHY

1. "Development and Application of the Method of Electrical Protection for Pipelines Against Soil Corrosion," Starr Thayer. A.P.I. 14th annual meeting. *A.P.I. Production Bulletin No. 212*, November, 1933. "Calculating Current and Potential Distribution in Cathodic Protection Systems," Walter F. Rogers. *The Petroleum Engineer*, December, 1940.
2. Bureau of Standards Technological Paper 108.
3. Technical Bulletin No. 1285 of James G. Biddle Company, Philadelphia.
4. H. B. Dwight, *Electrical Engineering*, December, 1936.

PROFITABLE PETROLEUM PRODUCTION

Drills and pumps must be kept working steadily to produce production profits. And Hyatt Roller Bearings throughout the petroleum field—minimizing friction—increasing performance—reducing shutdowns to a minimum, are contributing in a large measure to this profitable production.

Hyatt engineers with their many years of experience applying anti-friction bearings to oil wells can help drills and pumps operate smoother and longer. Consultation without obligation. Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.

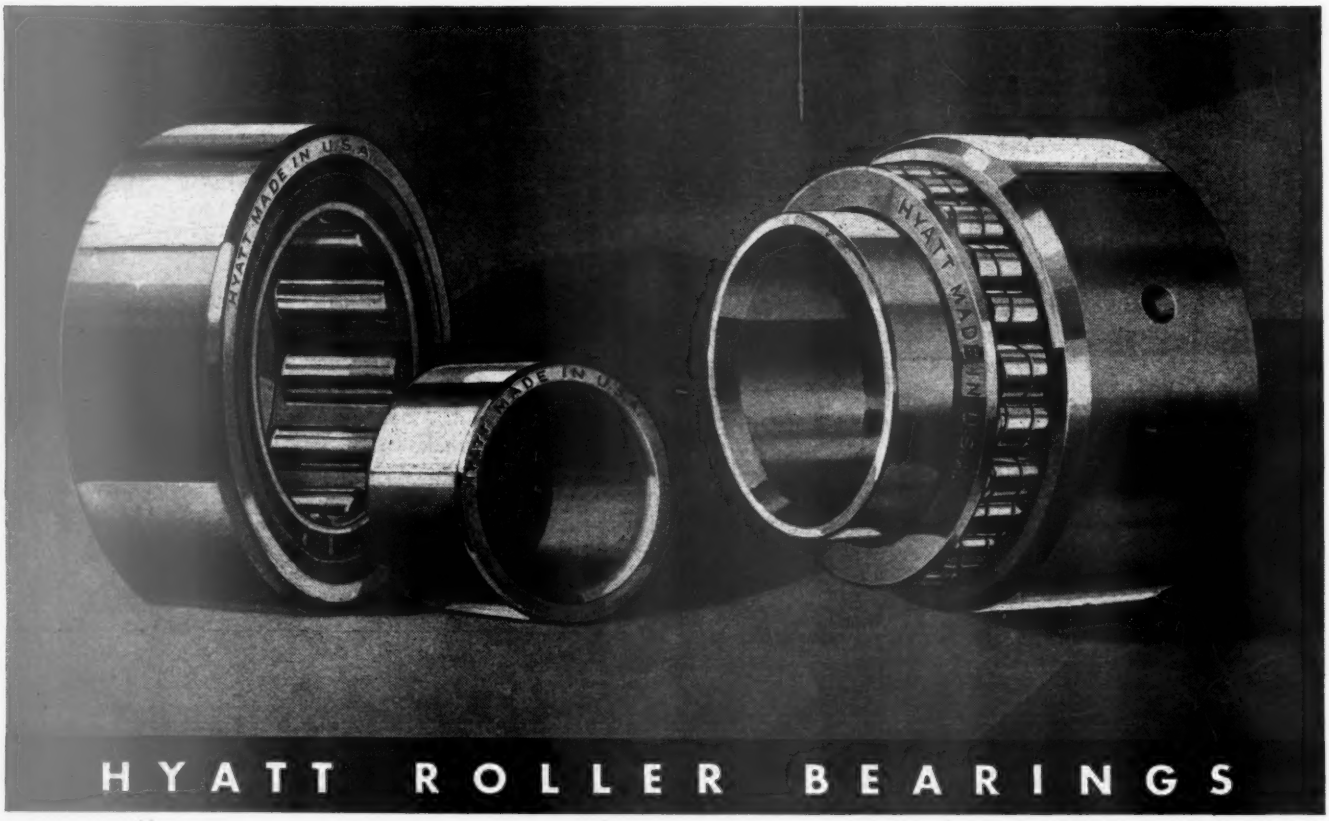


CHART FOR ESTIMATING HORSEPOWER FOR HOISTING

Example of use:

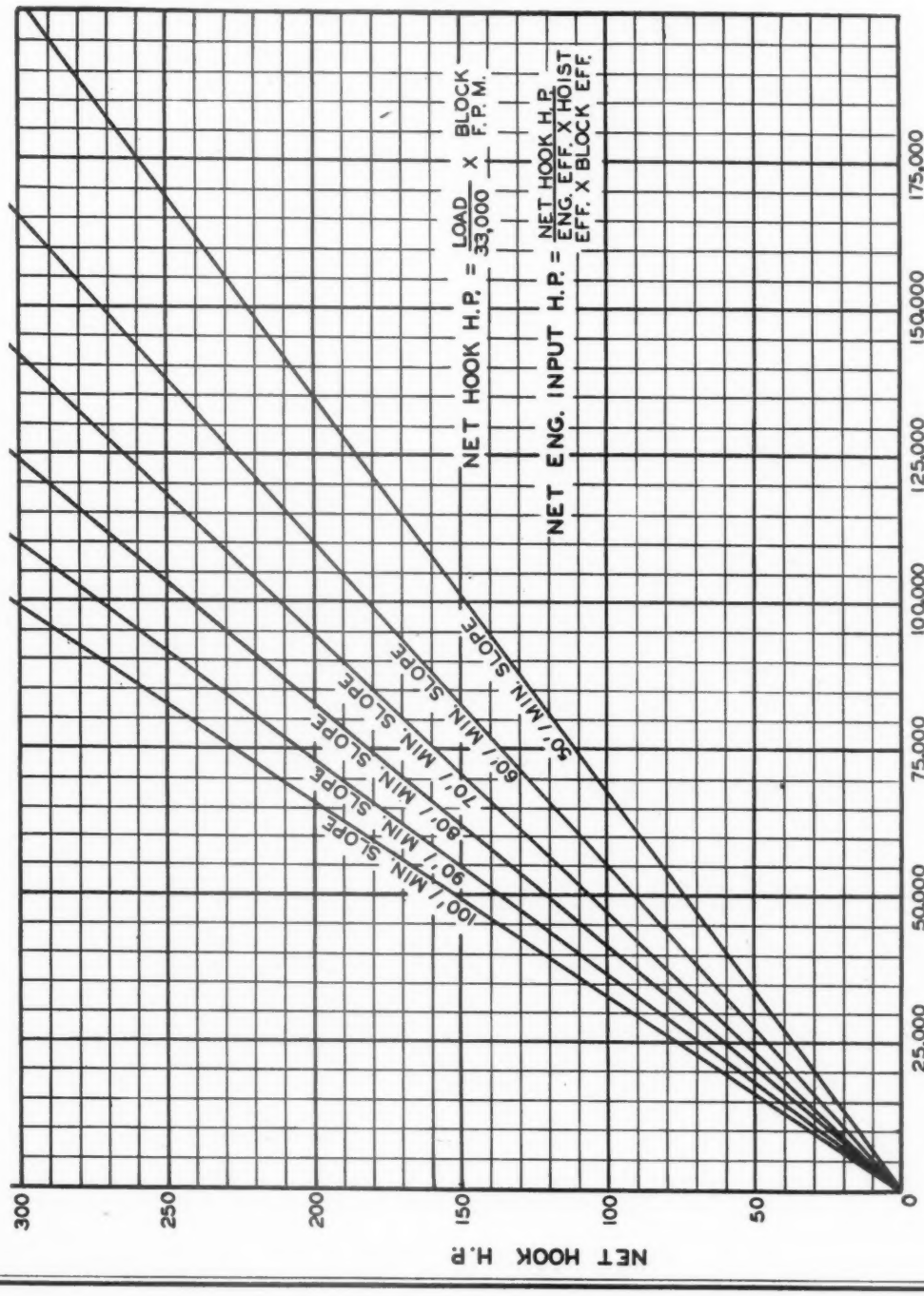
Given: A hook load of 81,000 lb. (10,000 ft. of 2½-in. tubing wet).

Required: The engine horsepower needed to hoist this load at the rate of 90 ft. per min. using a block with 4 lines.

Solution: Enter the chart from the 81,000 lb. load point on the lower scale. Follow upward to the diagonal line marked "90'/min. slope." Then, find the net hook hp. on the left-hand scale opposite the point of intersection = 221 hp.

Assuming the engine efficiency = 85 per cent; the hoist efficiency = 85 per cent; and the block efficiency = 96 per cent; then, the net engine hp. required =

$$\frac{221}{.85 \times .85 \times .96} = 320 \text{ hp.}$$



This chart is taken from the article entitled, "Selections of Internal-combustion Engines for Field Use," by James Moon, published in The Petroleum Engineer, September, 1946, page 57.

As free of stress as well-worn moccasins

HAZARD'S LAY-SET *Preformed* WIRE ROPE

You get true flexibility—limberness—willingness to bend—a wire rope that is easy to handle—when you put Hazard LAY-SET Preformed on your machine.

That is because every wire is preformed. It is the preforming process that frees the steel from internal torsional strains and pent-up stresses. It endows the rope with amazing resistance to bending fatigue, makes it spool better on drums, makes it easier to handle—reeve faster. All these characteristics add up to longer life, fewer machine shutdowns for rope replacement, steadier machine production, safer working conditions, greater dollar profit.

For your next line, order Hazard LAY-SET Preformed. Put it on your own machine, keep your own service records. Test it in your own way. Make it prove itself. It will.

Distributors in all strategic points

ACCO

Wilkes-Barre, Pa., Chicago, Pittsburgh, Houston, Wichita, San Francisco, Denver, Los Angeles, Bridgeport, Conn.

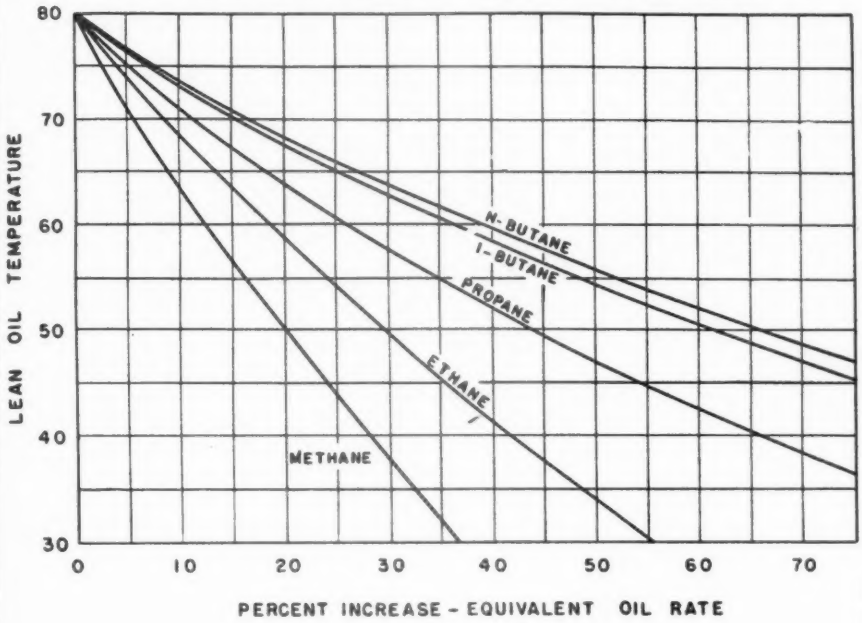
HAZARD WIRE ROPE DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

In Business for Your Safety

REFRIGERATION DATA FOR GASOLINE PLANTS

FIG. 1. OIL TEMPERATURES VS. EQUIVALENT OIL RATE.



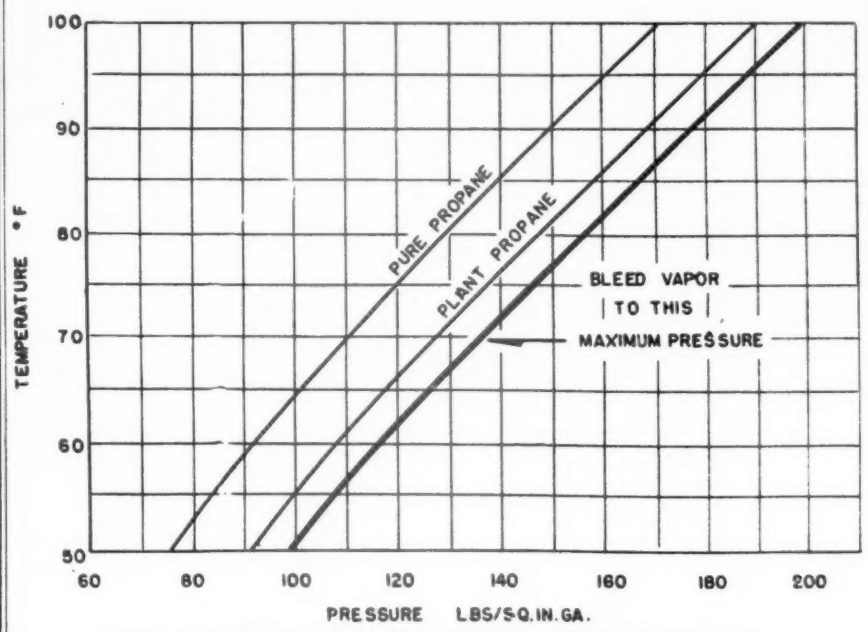


FIG. 2. CONDENSER, PRESSURE-TEMPERATURE CURVES.

These curves and table are taken from the article entitled "Practical Refrigeration for Natural Gasoline Plants," by R. W. Heath, J. B. Taylor, Jr., and P. W. Hill of the Signal Oil and Gas Company that was published in the May 1946 issue of *The Petroleum Engineer*, pages 162 to 176.

Fig. 1 (left) shows the relationship between lean oil temperatures below 80°F. and the increase in absorption of the oil as the temperature is reduced by refrigeration.

For example:

Lowering the temperature from 80°F. to 55°F. is equivalent to increasing the oil rate 50 per cent insofar as the butanes are concerned, 35 per cent for propane, 24 per cent for ethane, and 17 per cent for methane.

Fig. 2.—This is a curve based on the actual analysis data in Table 1 and shows that the refrigeration capacity is best when small quantities of vapor are removed by bleeding to a limited discharge pressure.

TABLE 1—Propane analysis.

	A	B	K	D	E	F
Analysis, mol per cent						
Carbon dioxide	2.10	0.30	7.00	0.00	0.15	0.10
Methane	7.35	0.51	14.41	0.00	0.19	Trace
Ethane	7.69	2.88	2.67	0.04	2.33	1.23
Propane	82.70	95.95	0.86	98.54	96.95	98.30
Isobutane	0.16	0.36	0.44	1.03	0.38	0.27
Normal butane	0.00	0.00		0.39	0.00	Trace
Total	100.00	100.00		100.00	100.00	100.00
Specific gravity	1.421	1.531		1.551		

Explanation of Table 1:

A—Condenser accumulator vapor, 172 lb. per sq. in. abs. and 79 °F.
B—Condenser accumulator liquid, 172 lb. per sq. in. abs. and 79 °F. Plant propane before any bleeding—vapors to compressor.
K—Equilibrium constants, A/B.
D—Liquid in chiller—lube oil removed.
E—Condenser accumulator liquid, 162 lb. per sq. in. abs. and 79 °F. Plant propane after bleeding approximately 10 per cent off B.
F—Plant propane from Signal Hill plant.
Specific gravity taken by Edwards Balance.
A to D samples procured at Huntington Beach before bleeding and E after bleeding.

This Simple Compressor Meets the Complex Needs of a Changing Petroleum Industry

It's the Nash!

Here is a compressor presenting advantages found in no other device. Nash Compressors have only one moving part, rotating without metallic contact with the pump casing. No internal lubrication is required. Yet they produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure.

There are no valves, gears, pistons, sliding vanes, or other complicated wearing parts in a Nash. Compression is secured by an entirely different principle of operation. Because of this, gas pumping problems difficult with ordinary pumps are often easily handled by the Nash. For example, Nash Pumps are standard equipment in the Synthetic Rubber Industry, where they have met the needs of new and difficult processes.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. They maintain original performance over long periods. Service is assured by a nationwide net-work of Engineering Service offices. Instructive bulletin shows how they operate. Write for it.

One moving part.

No internal wearing parts.

No valves, pistons, or sliding vanes.

No internal lubrication.

Low maintenance.

Slugs of liquid entering pump do no harm.

Non-pulsating pressure.

Saves floor space.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

272 WILSON, SO. NORWALK, CONN.

GAS PIPE LINE DESIGN FACTORS

These factors and curves are taken from the article entitled "Solving Problems of Gas Pipe Line Design by Use of Significant Factors" by C. L. Brockschmidt and M. K. Hager that was published in The Petroleum Engineer in December, 1944, pages 142 to 164, inclusive.

APPENDIX II

Pipe line flow equation

General equation for gas pipe line flow (U. S. Bureau of Mines Monograph 6):

$$Q = 38.77 \frac{T_o}{P_o}\left[\frac{(P_1^2 - P_2^2)\ d^5}{G T_f L f}\right]^{\frac{1}{2}} \quad \ldots\ldots\ldots \quad (1)$$

Reynolds Number:

$$R_e = \frac{DUS}{Z} \quad \ldots\ldots\ldots\ldots\ldots \quad (2)$$

Where:

$$D = \frac{d}{12}$$

$$U = \frac{144\,Q}{86{,}400 \times 0.7854\ d^2}$$

$$S = 0.0766\ G$$

$$Z = \frac{7}{10^6}$$

$$R_e = \frac{d \times Q \times 144 \times 0.0766 \times G \times 10^6}{12 \times 86{,}400 \times 0.7854 \times d^2 \times 7} = 1.935 \frac{QG}{d}. \quad (3)$$

Nikuradse's coefficient of friction for smooth pipe:

$$f = 0.0008 + 0.0552\ R_e^{-0.237}$$

which may be expressed in regions of turbulent flow when R is greater than 5,000,000 and less than 14,000,000 as follows:

$$\frac{1}{f} = 52\left(\frac{QG}{d}\right)^{0.1461} \quad \ldots\ldots\ldots\ldots \quad (4)$$

Substituting the above value of 1/f in equation (1):

$$Q = 38.77 \frac{T_o}{P_o}\left[\frac{(P_1^2 - P_2^2)\ d^5}{G\ T_f\ L}\right]^{\frac{1}{2}}\left[52\left(\frac{QG}{d}\right)^{0.1461}\right]^{\frac{1}{2}}$$

$$= 435.87\left(\frac{T_o}{P_o}\right)^{1.0788} d^{2.6182}\left[\frac{(P_1^2 - P_2^2)}{G^{0.8539}\ T_f\ L}\right]^{0.5394} \quad \ldots\ldots \quad (5)$$

Equation (5) expresses the theoretical flow in smooth pipe according to Nikuradse's friction factor. An experience factor, E, may be introduced into the equation to represent the ratio of the known flow obtainable in commercial pipe lines to the theoretical flow in smooth pipe. Some operators refer to this factor as a pipe line "efficiency" factor. One major pipe line company has experienced values of E ranging from 0.925 to 0.95, the latter value representing the efficiency of a new line or a clean line just after a scraper has been passed through.

Equation (5) may be written:

$$Q = 435.87\left(\frac{T_o}{P_o}\right)^{1.0788}\left(\frac{1}{G}\right)^{0.46}\left(\frac{1}{T_f}\right)^{0.5394} \times \left[\frac{(P_1^2 - P_2^2)}{L}\right]^{0.5394} d^{2.6182}\ E \quad \ldots\ldots \quad (6)$$

Putting $T_o = 520°$ F. abs.
$T_f = 510°$ F. abs.
$P_o = 14.735$ lb. per sq. in. abs.
$G = 0.607$
$E = 0.925$

$$Q = 821\ d^{2.6182}\left[\frac{(P_1^2 - P_2^2)}{L}\right]^{0.5394} \quad \ldots\ldots\ldots \quad (7)$$

As $P_1/P_2 = r$, $P_2 = P_1/r$, and equation (7) can be written:

$$Q = 821\ d^{2.6182}\ P_1^{1.08}\left(\frac{r^2 - 1}{r^2}\right)^{0.5394}\left(\frac{1}{L}\right)^{0.5394} \quad \ldots\ldots \quad (8)$$

Equations (7) and (8) are used throughout this analysis as the general flow equations.

APPENDIX III

Derivation of equations for total horsepower and fuel

Section	Length	Flow	Station	Horsepower	Fuel
1	L_1	Q_1	H_1	$=bQ_1$	abQ_1
2	L_2	$Q_2=Q_1(1+ab)$	H_2	$=bQ_1(1+ab)$	$abQ_1(1+ab)$
3	L_3	$Q_3=Q_1(1+ab)^2$	H_3	$=bQ_1(1+ab)^2$	$abQ_1(1+ab)^2$
4	L_4	$Q_4=Q_1(1+ab)^3$	H_4	$=bQ_1(1+ab)^3$	$abQ_1(1+ab)^3$
n	L_n	$Q_n=Q_1(1+ab)^{n-1}$	H_{n-1}	$=bQ_1(1+ab)^{n-2}$	$abQ_1(1+ab)^{n-2}$

Total horsepower for n sections or (n—1) stations; (the field station is excluded):

$$H_t = H_1 + H_2 + H_3 + H_4 + \ldots H_{n-1} \quad \ldots\ldots \quad (9)$$

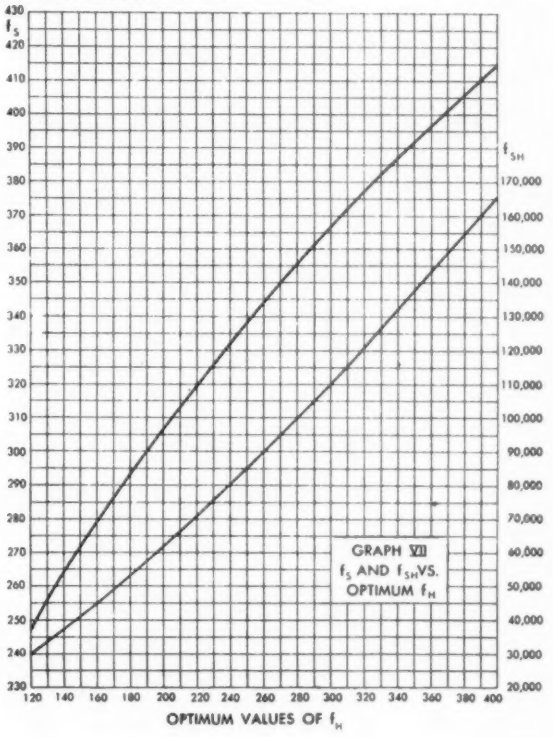
$$= bQ_1[1+(1+ab)+(1+ab)^2+(1+ab)^3+\ldots + (1+ab)^{n-2}] \quad \ldots\ldots\ldots\ldots \quad (10)$$

$$= bQ_1\left[\frac{(1+ab)^{n-1} - 1}{(1+ab) - 1}\right] \quad \ldots\ldots\ldots \quad (11)$$

$$= \frac{Q_1}{a}\left[(1+ab)^{n-1} - 1\right] \quad \ldots\ldots\ldots \quad (12)$$

Total fuel for n sections or (n—1) stations; (the field station is excluded):

$$F_t = aH_t = Q_1\left[(1+ab)^{n-1} - 1\right] \quad \ldots\ldots\ldots \quad (13)$$



Graph VII plots the optimum values of f_H vs. f_S and f_{SH}, for pipe stressed to 35,715 lb. per sq. in. and compressors having a mechanical efficiency of 90 per cent.

Graph VII is especially useful for finding optimum solutions of a given problem involving many combinations of compressor horsepower and pipe size.

BEGINNING OF THE

"BIG DITCH"

. . . also marked the start of TOLEDO Leadership in Pipe Tools!

● It was a big forward step in 1902 . . . when our country bought the rights and franchises for the Panama Canal from France. This greatly strengthened our growing leadership in world commerce and world affairs.

It was also in that same year—44 years ago—that a new name in Pipe Tools was born. With a modest start in small factory quarters . . . this was the beginning of TOLEDO Leadership as producers of Pipe Tools of outstanding Accuracy and Quality.

Through the years . . . the name TOLEDO has been a familiar symbol of dependability and long-life economy among pipe mechanics in all fields. It's the name you can trust today *and tomorrow!* The Toledo Pipe Threading Machine Company, Toledo, Ohio. New York Office, No. 2 Rector Street Building.

TOLEDO

PRECISION PIPE TOOLS

The first TOLEDO Catalog published in August 1902 was 12 pages size 3" x 6" showing 4 tools —Models 1, 1A, 2 and 3. Our catalog today requires 60 pages size 8½" x 11" to describe the many models in the complete Toledo line.

"TOLEDO"

GAS PIPE LINE DESIGN FACTORS

APPENDIX IV

Derivation of equations for graduating the interval between compressor stations to obtain the same compression ratio at full load

The general flow equation can be written:

$$Q = k\,d^{2.618}\left[\frac{(P_1^2 - P_2^2)}{L}\right]^{0.54}$$

$$(P_1^2 - P_2^2)^{0.54} = \frac{Q\,L^{0.54}}{k^{1.85}}$$

$$(P_1^2 - P_2^2) = \frac{L\,Q^{1.85}}{k^{1.85}}$$

$$L\,Q^{1.85} = k^{1.85}\,(P_1^2 - P_2^2) \quad \ldots\ldots\ldots\ldots \quad (14)$$

For any given pipe line, if the compression ratio is the same and constant at all compressor stations, $(P_1^2 - P_2^2)$ must be equal and constant for each section and:

$$L_n Q_n^{1.85} = K \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (15)$$

Where:

L_n = length of section, miles, and

Q_n = flow in section, million cu. ft. per 24 hr.

The relationship between flow and length is shown in the following series:

Section	*Length*	*Flow*	$L_nQ_n^{1.85} = K$	
1	L_1	Q_1	$L_1Q_1^{1.85}$	$= K$
2	L_2	$Q_1(1+ab)$	$L_2Q_1^{1.85}\,(1+ab)^{1.85}$	$= K$
3	L_3	$Q_1(1+ab)^2$	$L_3Q_1^{1.85}\,(1+ab)^{1.85\times2}$	$= K$
4	L_4	$Q_1(1+ab)^3$	$L_4Q_1^{1.85}\,(1+ab)^{1.85\times3}$	$= K$
5	L_5	$Q_1(1+ab)^4$	$L_5Q_1^{1.85}\,(1+ab)^{1.85\times4}$	$= K$
n	L_n	$Q_1(1+ab)^{n-1}$	$L_nQ_1^{1.85}\,(1+ab)^{1.85(n-1)}$	$= K$

$$L_1Q_1^{1.85} = L_2Q_1^{1.85}\,(1+ab)^{1.85} = L_3Q_1^{1.85}\,(1+ab)^{1.85\times2} = L_nQ_1^{1.85}\,(1+ab)^{1.85(n-1)} = K \quad \ldots\ldots\ldots \quad (16)$$

$$\frac{L_2}{L_1} = \frac{Q_1^{1.85}}{Q_1^{1.85}\,(1+ab)^{1.85}} \text{ and } L_2 = \frac{L_1}{(1+ab)^{1.85}} \quad \ldots \quad (17)$$

$$\frac{L_3}{L_1} = \frac{Q_1^{1.85}}{Q_1^{1.85}\,(1+ab)^{1.85\times2}} \text{ and } L_3 = \frac{L_1}{(1+ab)^{1.85\times2}} \quad (18)$$

$$\frac{L_n}{L_1} = \frac{Q_1^{1.85}}{Q_1^{1.85}\,(1+ab)^{1.85(n-1)}} \text{ and } L_n = \frac{L_1}{(1+ab)^{1.85(n-1)}} \quad (19)$$

$$L_t = L_1 + L_2 + L_3 + \ldots + L_n \quad \ldots\ldots\ldots\ldots \quad (20)$$

$$= L_1\left[1 + \frac{1}{(1+ab)^{1.85}} + \frac{1}{(1+ab)^{1.85\times2}} + \frac{1}{(1+ab)^{1.85\times3}} + \ldots + \frac{1}{(1+ab)^{1.85(n-1)}}\right] \quad \ldots \quad (21)$$

$$= L_1\left[\frac{\left[\frac{1}{(1+ab)^{1.85n}} - 1\right]}{\left[\frac{1}{(1+ab)}\right]^{1.85} - 1}\right] \quad \ldots\ldots \quad (22)$$

$$= L_1\left[\frac{1-(1+ab)^{1.85n}}{(1+ab)^{1.85n}}\right]\left[\frac{(1+ab)^{1.85}}{1-(1+ab)^{1.85}}\right] \quad (23)$$

$$= L_1\left[\frac{1-(1+ab)^{1.85n}}{1-(1+ab)^{1.85}}\right]\left[\frac{1}{(1+ab)^{1.85(n-1)}}\right] \quad (24)$$

$$\frac{L_1}{L_t} = \frac{[1-(1+ab)^{1.85}]\;(1+ab)^{1.85(n-1)}}{1-(1+ab)^{1.85n}} \quad (25)$$

APPENDIX V

Derivations of significant factors and their use as mathematical operatives in the solution of pipe line problems

The general flow equation for the standard conditions stated in Appendix I is written:

$$Q_1 = \frac{821}{10^6}\left(\frac{r^2-1}{r^2}\right)^{0.54}\frac{P_1^{1.08}d^{2.618}}{L_1^{0.54}}$$

Where:

Q_1 = deliverability of market terminal section, million cu. ft. per 24 hr.,

L_1 = Length of terminal section, miles,

P_1 = maximum allowable discharge pressure, lb. per sq. in. abs.,

r = ratio of compression, and

d = inside diameter of pipe, in.

The common formula for the maximum working pressure at the allowable circumferential stress in thin-walled tubes is as follows:

$$P_1 = \frac{2st}{\Phi\,d} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (26)$$

Where:

P_1 = maximum allowable working pressure, lb. per sq. in.,

t = wall thickness, in.,

d = inside diameter, in.,

Φ = design factor of safety, and

s = ultimate fiber stress of material, lb. per sq. in.

For Grade "B" steel stressed to 35,715 lb. per sq. in., $\Phi = 1.4$ and

$$P_1 = \frac{2 \times 50{,}000\;t}{1.4\,d} = \frac{10^5 t}{1.4d} \quad \ldots\ldots\ldots\ldots \quad (27)$$

Substituting the above value of P_1 in the general flow equation:

$$Q_1 = \frac{821}{10^6}\left(\frac{r^2-1}{r^2}\right)^{0.54}\left(\frac{10^5 t}{1.4d}\right)^{1.08}\frac{d^{2.618}}{L_1^{0.54}} \quad \ldots\ldots \quad (28)$$

$$= \frac{821 \times 10^{5.40}}{10^6 \times 1.438}\left(\frac{r^2-1}{r^2}\right)^{0.54}\frac{t^{1.08}\,d^{2.618}}{d^{1.08}\,L_1^{0.54}} \quad \ldots\ldots \quad (29)$$

$$= 143.5\left(\frac{r^2-1}{r^2}\right)^{0.54}\frac{t^{1.08}\,d^{1.538}}{L_1^{0.54}} \quad \ldots\ldots\ldots \quad (30)$$

Multiplying equation (30) by $(L_t)^{0.54}$ and dividing by $(t^{1.08}\,d^{1.538})$:

$$\frac{Q_1\,L_t^{0.54}}{t^{1.08}\,d^{1.538}} = 143.5\left(\frac{r^2-1}{r^2}\right)^{0.54}\left(\frac{L_t}{L_1}\right)^{0.54} \quad (31)$$

Substituting for $\left(\frac{L_t}{L_1}\right)$ the reciprocal of equation (25) in Appendix IV, equation (31) becomes:

$$\frac{Q_1\,L_t^{0.54}}{t^{1.08}\,d^{1.538}} = 143.5\left(\frac{r^2-1}{r^2}\right)^{0.54} \times \left[\frac{1-(1+ab)^{1.85n}}{[1-(1+ab)^{1.85}]\;(1+ab)^{1.85(n-1)}}\right]^{0.54} \quad \ldots \quad (32)$$

Equation (32) may be written:

$$\frac{Q_1\,f_L}{f_P} = f_S \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (33)$$

Continued on Sheet No. 10

These factors are taken from the article entitled "Solving Problems of Gas Pipe Line Design by Use of Significant Factors" by C. L. Brockschmidt and M. K. Hager that was published in The Petroleum Engineer in December, 1944, pages 142 to 164, inclusive.

THE ECONOMICS OF CORROSION-PROOF PIPELINES

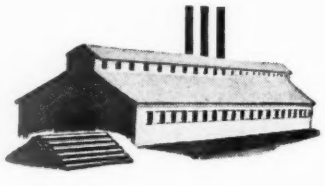
require

- Stability of protective coating
- Modern application and electrical inspection
- Cathodic protection

The electrical insulating properties of Barrett Coal-tar Enamels are not affected by varying moisture content of the soil during changes in weather, season or time itself—factors which are necessary to make cathodic protection effective and economical.

Over the years, uniformly satisfactory results have been obtained when Barrett Coal-tar Enamels have been applied by modern methods, and electrically inspected, to insure continuity of the electrical insulation.

Protection applied in transit



Modern equipment for the proper application of primers and enamels over mechanically cleaned pipe is available at numerous application contractors' plants, which apply Barrett protective coating systems while the pipe is in transit to your destinations.

Protection applied in the field

Thousands upon thousands of miles of pipelines have been protected with Barrett primers, enamels and asbestos felts, application being made over the ditch with modern traveling coating equipment and with increasing efficiency and low costs.

Either way, the combination of proved coating materials and proved application methods will assure the economy of your investment in cathodic protection.

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

FIELD SERVICE: The Barrett Pipeline Service Department and staff of Field Service men are equipped to provide both technical and on-the-job assistance in the use of Barrett Enamel.

Barrett COAL-TAR ENAMEL

. . . an important factor in

THE ECONOMICS OF CATHODIC PROTECTION

GAS PIPE LINE DESIGN FACTORS

Appendix V—Continued

Where:

f_L = length factor = $L_t^{0.84}$

f_P = pipe factor = $t^{1.08}\, d^{1.538}$

f_S = station factor = $143.5 \times \left(\frac{r^2-1}{r^2}\right)^{0.54} \left[\frac{1-(1+ab)^{1.85n}}{[1-(1+ab)^{1.85}]\,(1+ab)^{1.85(n-1)}}\right]^{0.54}$

It is readily apparent that f_L is a function of the total length of the pipe line and f_P is a function of the wall thickness and diameter of the pipe. When f_L and f_P are combined with Q_1, the deliverability of the terminal section, as shown in equation (33), the result is a station factor, f_S, which is a complex function of the number of compressor stations, compression ratio, fuel, and the compressor b.hp. required for each compression per million cu. ft. pumped per 24 hr.

In Appendix III it was shown that:

$$H_t = \frac{Q_1\,[(1+ab)^{n-1}-1]}{a}$$

where H_t = total compressor b.hp. in all stations except the field station.

The above equation may be written:

$H_t = Q_1\, f_H$

where f_H = hp. factor $= \frac{(1+ab)^{n-1}-1}{a}$ . . . . . (34)

The horsepower factor, f_H, may be defined as the total compressor b.hp. required in all stations (except the field station) per million cu. ft. delivered per 24 hr. at the market terminus.

For the solution of certain types of problems where Q_1 is unknown it is convenient to use a mathematical operative, f_{SH}, which is the product of f_S and f_H. Thus:

$f_{SH} = f_S \times f_H$ . . . . . (35)

$= \frac{f_L\, Q_1}{f_P} \times \frac{H_t}{Q_1} = \frac{f_L\, H_t}{f_P}$ . . . . . (36)

The following standard conditions and values of constants were used to compute the graphs:

(a) In the flow equation, as stated in Appendix II:

$T_o = 520°$ F. abs.
$T_f = 510°$ F. abs.
$P_o = 14.735$ lb. per sq. in. abs.
$G = 0.607$
$E = 0.925$

Values of f_S and f_{SH} are affected by changes in the above assumed conditions and should be multiplied by a correction factor computed as indicated by equation (6) in Appendix II. The other factors are not affected by changes in the flow conditions.

Changes in specific gravity are most often encountered in flow problems and a few correction factors, C_G, for specific gravity are computed as follows:

Sp. gr. G	Correction factor $C_G = (0.607/G)^{0.46}$
0.560	1.038
0.580	1.021
0.600	1.006
0.607	1.000
0.620	0.990
0.640	0.976
0.660	0.962
0.680	0.949
0.700	0.936

(b) In the equation for f_S, as stated under equation (33):

$$f_S = 143.5\left(\frac{r^2-1}{r^2}\right)^{0.54}\left[\frac{1-(1+ab)^{1.85n}}{[1-(1+1.85](1+ab)^{1.85(n-1)}}\right]^{0.54}$$

Where:

a = fuel gas consumed per compressor b.hp. per 24 hr.
$= 11 \times 24 \times 10^{-6} = 0.000264$ million cu. ft.

b = compressor b.hp. required to pump one million cu. ft. of gas per 24 hr. (measured at 14.735 lb. per sq. in. abs. and suction temperature), mechanical efficiency = 90 per cent and $c_p/c_v = 1.275$ as follows:

Compression ratio (r)	B.hp. per million cu. ft. per 24 hr. (b)	(1 + ab)
1.2	15.9	1.004198
1.3	21.0	1.005544
1.4	25.4	1.006706
1.5	29.3	1.007735
1.6	32.8	1.008659
1.7	36.4	1.009610
1.8	39.3	1.010375
1.9	42.1	1.011114
2.0	44.8	1.011827
2.1	47.5	1.012540
2.2	50.1	1.013226

(c) Values of f_S on the graphs are affected only negligibly by minor changes in the value of b such as the change brought about by the difference in mechnical efficiency of horizontal and angle type compressors. On the other hand, values of f_H and f_{SH} are affected in direct proportion to the value of b. For most gases the change in b caused by normal variations in the c_p/c_v ratio is too small to take into account in the graphs, but when they are used for horizontal compressors having a mechanical efficiency of 90 per cent, values of f_H and f_{SH} must be multiplied by the correction factor,

$$C_E = \frac{0.90}{0.95} = 0.947$$

(d) In the derivation of the equation for f_S, as described in Appendix V, the ultimate fiber stress, s, of the steel in the pipe was taken to be 50,000 lb. per sq. in., the mill guarantee for Grade B material. The allowable working stress of such material at a 1.4 design factor of safety:

$$\frac{s}{\Phi} = \frac{50{,}000}{1.4} = 35{,}715 \text{ lb. per sq. in.}$$

For other working stresses the values of f_S and f_{SH} shown on the graphs accompanying this article must be multiplied by a correction factor, C_S, computed as shown in the following table. Values of f_H are not affected by changes in the working stress.

Working stress $\left(\frac{s}{\Phi}\right)$	Correction factor $C_S = \left(\frac{s}{\Phi \times 35{,}715}\right)^{1.08}$
26,000	0.690
28,000	0.753
30,000	0.815
32,000	0.878
34,000	0.943
35,715	1.000
36,000	1.008
38,000	1.068
40,000	1.129

These factors are taken from the article entitled "Solving Problems of Gas Pipe Line Design by Use of Significant Factors" by C. L. Brockschmidt and M. K. Hager that was published in The Petroleum Engineer in December, 1944, pages 142 to 164, inclusive.

2M—7-46—No. 2521

There's Gold *IN STEEL SCRAP*

HERE IS THE WAY TO GET IT

Steel producers urgently need scrap.

Millions of tons of steel products that have served their usefulness are piled throughout the country. Cut it to charging box size and start it moving. Idle scrap means idle mills and idle fabricating plants.

Linde can supply the oxygen, acetylene, cutting equipment, and technical help for any scrapping operation.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

Plenty of activity here — the coating and wrapping machine operating on a section of the line that contains both a sag and a side bend within a limited space.

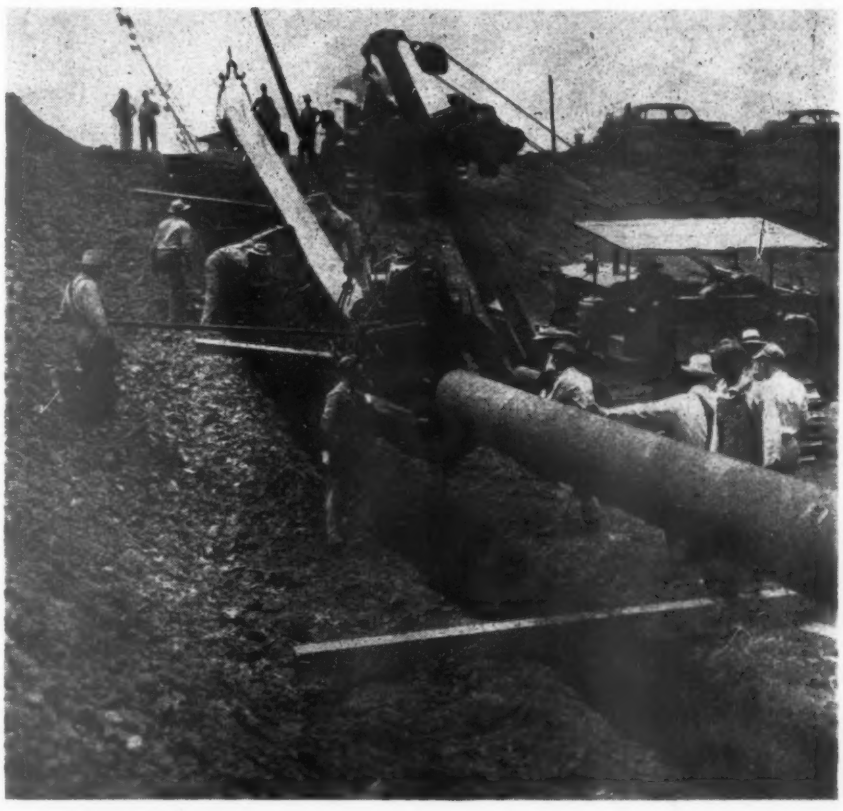
Stanolind increases capacity

By **FRANK H. LOVE,** *Managing Editor*

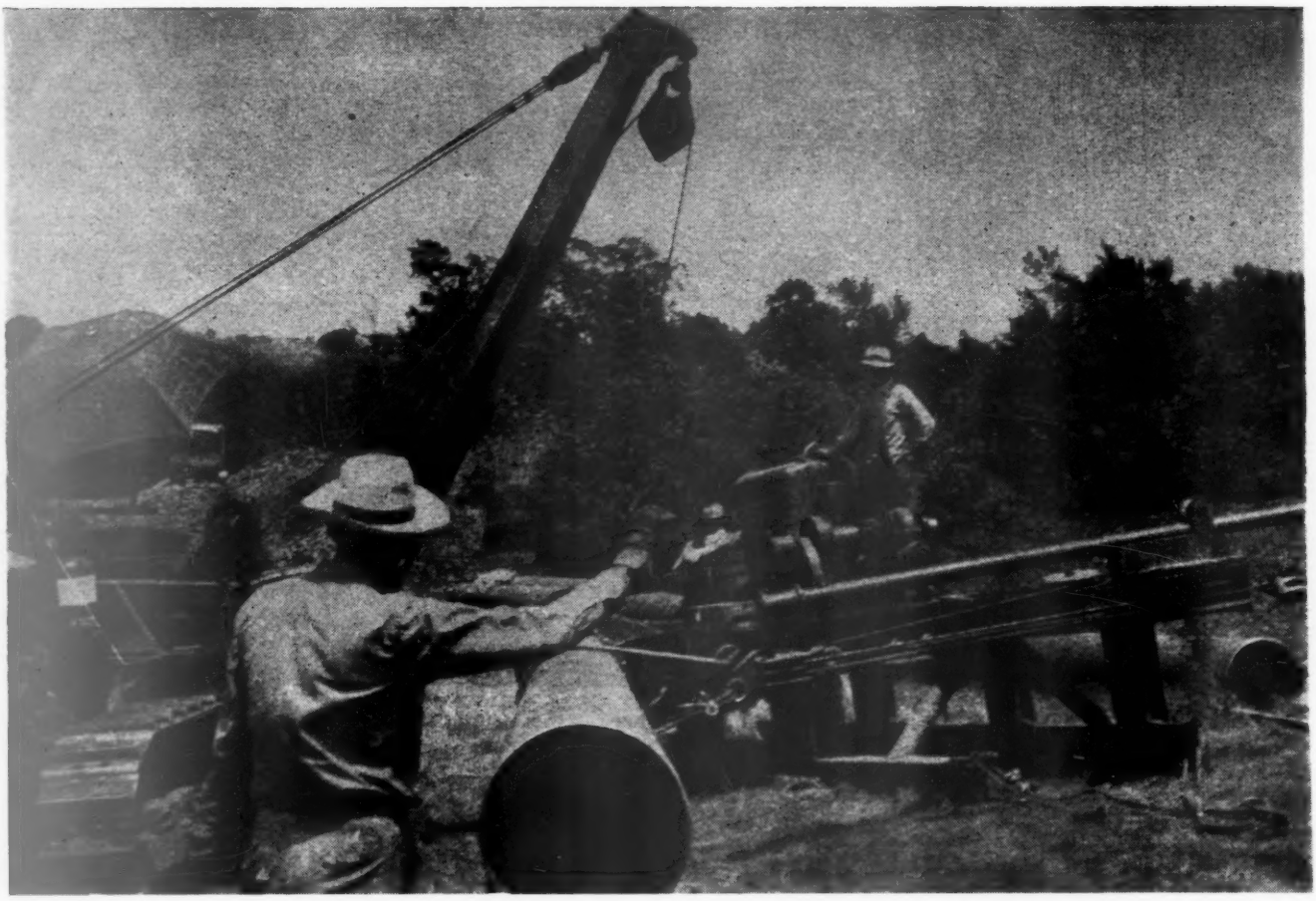
EXCLUSIVE

THE largest diameter crude oil pipe line to be constructed in the United States other than the Big Inch and Little Big Inch war emergency lines was completed the latter part of September by the Stanolind Pipe Line Company. The line is a 20-in. carrier extending 148 miles from Freeman, Missouri, to La Plata, Missouri, the latter a point on the company's Chicago line where its 12-in. line branches off to serve the Wood River, Illinois, refinery. This addition to its system, which was laid principally along the existing right-of-way, provides the Wood River refinery with increased crude oil stocks. Between LaPlata and Wood River two new pumping stations will be installed to supply the capacity for moving the greater volume of oil through the line.

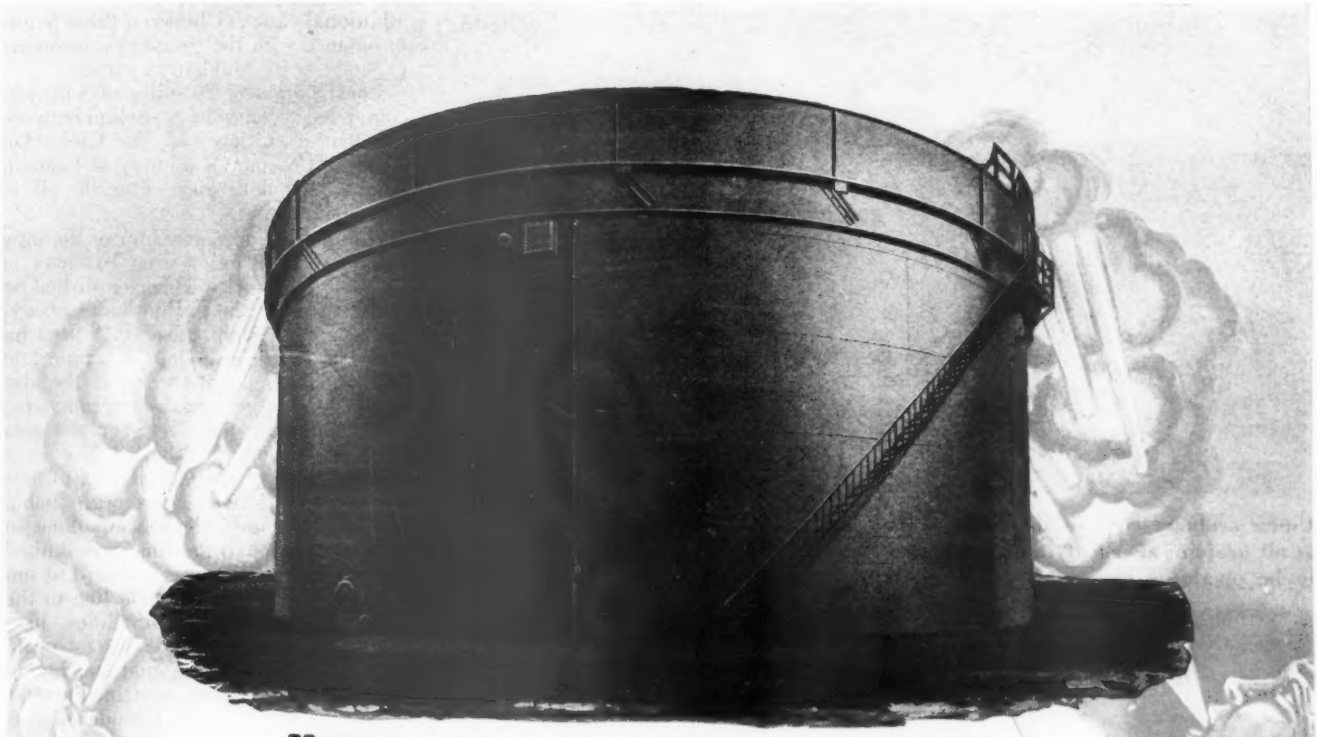
Also as part of the enlargement program, a combination 14 and 18-in. line 30 miles in length was laid between Manhattan, Illinois, and Little Calumet Junction, the latter point seven miles south of Whiting, Indiana. This line provides



Another coating scene with the traveling-type machine ready to start uphill.



Above, bends in the large-diameter pipe were made cold with this bending machine. Below, after being coated and wrapped a holiday detector was run to find defects in the coating, which were patched before pipe was lowered into ditch.



"RAISING THE ROOF"

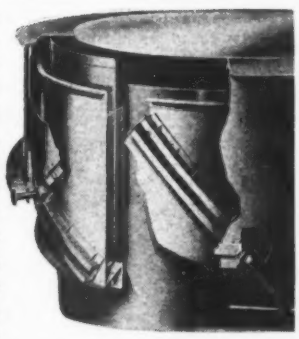
can be a profitable proposition . . . if it's

A HAMMOND VAPOR-LIFT

What to do about breathing and filling losses has always been a problem with cone roof tanks . . . many operators believe there is little that can be done or that it doesn't pay to do anything about it. . . . not so with the owners (a major company) of this Hammond ***Vapor-Lift*** Tank which they had built and connected with three cone roof tanks . . . now there is no loss from breathing or filling . . . and the ***Vapor-Lift*** Tank will pay for itself in a very reasonable period of time.

The ***Vapor-Lift*** Tank has full liquid storage capacity and in addition the roof raises itself everytime the vapor pressure increases and lowers itself as the vapors diminish . . . it is the "lung" which stores the vapors generated in the three cone roof tanks. Without this ***Vapor-Lift*** Tank the vapors formed in the three cone roof tanks would be exhausted into the atmosphere with an attendant loss in quantity as well as quality.

Hammond ***Vapor-Lift*** Tanks can be built to capacities of 100,000 barrels to provide a variable vapor space of ample capacity to permit the expansion or contraction of vapors, to eliminate tank breathing losses, reduce filling losses and maintain the quality of the stored product in one or a number of cone roof tanks.



The simple mechanism, which directs and stabilizes the upward and downward movement of the roof, consists of nothing but a track placed at regular intervals at an angle of 45 degrees; a roller guide rides in this track and other roller guides, placed at 90 degrees to the rollers in the tracks, ride against the side of the tank and take any lateral load such as from high winds. The bearings of the roller guides are self-lubricating to minimize maintenance and repair. This simple stabilizing mechanism prevents binding of the tank roof even under conditions of unequal loads caused by snow, ice, settled tank foundations, etc.

HAMMOND
IRON WORKS
Warren, Pa.

NEW YORK • BOSTON • PITTSBURGH • AKRON
DETROIT • CLEVELAND • CINCINNATI • RICHMOND
CHICAGO • ARGENTINA; "TIPSA", BUENOS AIRES

HAMMOND designs, fabricates and erects tanks of all types for liquid and dry storage . . . above or below ground . . . high or low pressure . . . cone roof . . . HAMMOND SPHERE . . . floating roof . . . VAPOR-LIFT . . . spheroid . . . GLOBE ROOF PRESSURE . . . gas holder . . . also stainless and stainless-clad vessels of all types and designs for the petro-chemical industries.

Under ordinary circumstances the ditchers had no trouble at all keeping ahead of the pipe "gangs". This one seems to be operating through a rather easily ditched area.

Because of the weight of the large-diameter pipe heavy-duty side-boom tractors were used for lining-up and lowering-in.

The line was laid of seamless pipe of 40-ft. random lengths and was welded throughout by the electric-arc method.

additional capacity between these points to balance with the company's incoming capacity at its Manhattan station.

Construction of 20 miles of 8-in. was completed recently by Stanolind between Manhattan station and the Globe Oil Refining Company's refinery at Lemont, Illinois, for deliveries of crude oil to that company.

Despite the large diameter of the pipe laid in the 148 miles from Freeman to La Plata, the work was accomplished by conventional methods. Pipeliners, always a resourceful group, have never been inclined to view the laying of a pipe line as a problem, no matter what the size of the pipe, conditions of terrain, etc., may be. During the war when the government needed a 24-in. oil line in a hurry to move crude oil to the East Coast because too many tankers were being sunk off the coasts, the job was done on schedule, although the time was limited and a 24-in. oil line was unheard of until then. The 20-in. products line to the East and other emergency lines, likewise, were "taken in stride," so to speak. So, it is not surprising that the laying of this Stanolind line, next in diameter size to the Big Inch as a crude oil carrier, was considered a "routine" operation by those in charge.

The line was laid of seamless pipe of 40-ft. random lengths, and was welded throughout by the electric-arc method. With the welded pipe on skids over the pipe-line trench, a conventional traveling-type cleaning machine equipped with priming head was run to remove mill scale and dirt and apply the primer paint. Following at a proper distance came the traveling-type coating and wrapping machine. The line was coated over its entire length with 5/32 in. of hot asphalt, and was given a single wrap of asbestos felt. Because of the weight of the large-diameter pipe heavy-duty side-boom tractors were required for lining-up and lowering-in.

In laying the 20-in. line it was unnecessary to make any major river crossings. The Stanolind system crosses the Missouri River near Waverly, Missouri, but in this instance the laying of a river crossing was avoided by tying the 20-in. line into existing lines at the south bank junction of the river and again at the north bank junction.

The two new stations will be at Auburn, Missouri, and Center, Missouri, and will be constructed as soon as the required materials are available. In the meantime, existing pumping equipment will handle the load. The two stations will have identical pumping units. These will consist of one 1250-hp. 4-cycle 257-r.p.m. supercharged Alco diesel direct connected to a vertical single-acting Aldrich quintiplex pump operating at engine speed. The pumping set-up will develop 1000-lb. line pressure.

Three general contractors were in charge of the work of laying the lines: Bechtel Brothers McCone Company, San Francisco, California; Oklahoma Contracting Company, Dallas, Texas, and Sheehan Pipe Line Construction Company, Tulsa, Oklahoma. ★ ★ ★

Legal Holiday

. . . NOT ON PIPELINES protected with NO-OX-ID and NO-OX-IDized wrappers . . .

Electrical testing reveals no holidays on this NO-OX-ID-protected pipe. Regardless of your protection problem, NO-OX-ID protection is available to end corrosion troubles.

Pits or corrosion present at the time of application are deactivated by NO-OX-ID. Corrosion cannot start beneath these coatings. And outside moisture cannot readily penetrate NO-OX-IDized wrappers; cannot reach the pipe or shorten its life. NO-OX-IDized wrappers are heavily reinforced for permanence, and impregnated with NO-OX-ID for complete lasting protection.

Applied hot or cold, by hand or by traveling machine, NO-OX-ID and NO-OX-IDized wrappers shut the door on corrosion—your assurance that when pipe goes down, it is down to stay.

The ORIGINAL RUST PREVENTIVE

Dearborn Chemical Company
Dept. L, 310 S. Michigan Ave., Chicago 4, Ill.
New York • Los Angeles • Toronto

New rotary tool is used to keep drill pipe free

By K. MARSHALL FAGIN
Field Editor

A NEW tool, designed to prevent drill pipe from becoming stuck as it is being pulled out of crooked holes, was used recently for the first time in a directionally drilled well to test its ability to keep the drill collars from sticking in key seats that were formed in the doglegs where the hole had been deflected.

EXCLUSIVE

The tool, named a "Burris key seat wiper" by its inventor, Joe J. Burris, is simply a steel sleeve mounted slidably on a mandrel that is placed between the drill pipe and the drill collars. The outside diameter of the sleeve is slightly larger than the outside diameter of the drill collars, and a special "bumper" sub is used on top of the mandrel instead of a regular drill pipe tool joint.

The sleeve is splined to the mandrel on the lower end so that it rotates as an integral part of the drillstem as drilling proceeds, but, being slightly larger in diameter than the drill collars, it will tend to wipe out or stick in any key seats that obstruct it from being pulled out of the hole. The entire drill string may then be lowered about 2 ft. and rotated without turning the sleeve. This would show that only the sleeve is stuck.

● **Wiper sleeve may be worked up through key seat.** Then, either by alternately dropping weight on the sleeve and pulling up against it, or by pulling up and rotating, the tool may be worked up through the key seat. The drill collars are unlikely to stick, due to their smaller diameter. Whether the tool sticks in a key seat or not, it tends to keep the hole large enough to minimize the danger of sticking the drill collars by a scraping or wiping action each time the drilling string is withdrawn from the hole.

The accompanying drawings and pictures show details of the second model of the tool. The first model had splines that were 2-in. wide. The width of splines was reduced to supply more area of flat contact between the bottom of the sleeve and the face of the mandrel that it rests upon, but the sleeve on the first model being used in the Sugar Valley field of Matagorda County, Texas, does not appear to be wearing out rapidly due to the wide spline, and the wide spline seems to operate more satisfactorily than the narrow one.

The plat and vertical cross-section of the first directionally drilled well in which the tool has been used shows the way the well was deflected to reach and test sands on the flank of a salt dome in Calcasieu Parish, Louisiana.

● **Six whipstocks used to change the course or angle of the directionally drilled well.** The well was begun on July 31, 1946, and 10¾-in. surface casing was set and cemented at 518 ft. The plug was drilled, and the hole was kept about vertical to a depth of 1118 ft. Then a whipstock was set to deflect the course of the hole to the west. Another whipstock was used to change the course of the hole at 1335 ft.

Altogether, the direction of the original hole was changed six times before it was plugged back to 3305 ft. from a total depth of 5124 ft. Reamers were used continuously above the bit and most of the time one or two line reamers were used to keep key seats in the doglegs from sticking the drill collars when the pipe was pulled, but difficulty was encountered in pulling the pipe on two trips.

After the hole was plugged back and drilled to a depth of 3632 ft. on the first sidetrack, the Burris key seat wiper was placed between the 40-ft. section of 7¼-in. drill collars and the 4½-in. drill pipe. Reamers were used above the 9⅞-in. bits, and line reamers were used frequently between 950 and 2100 ft. to keep the key seats open. Then, when the well reached a total depth of 4834 ft., all reamers were removed from the string.

● **New key seat wiper used effectively.** The well was continued for five days without reamers and without difficulty in pulling the pipe to change bits two or three times every day. The key seat at 1100 ft. that had caused difficulty in pulling the pipe prior to the installation of the key seat wiper never caused any more delays after the wiper was installed.

When pulling the drillstem from a total depth of 5700 ft., however, a key seat was encountered at 2300 ft. The

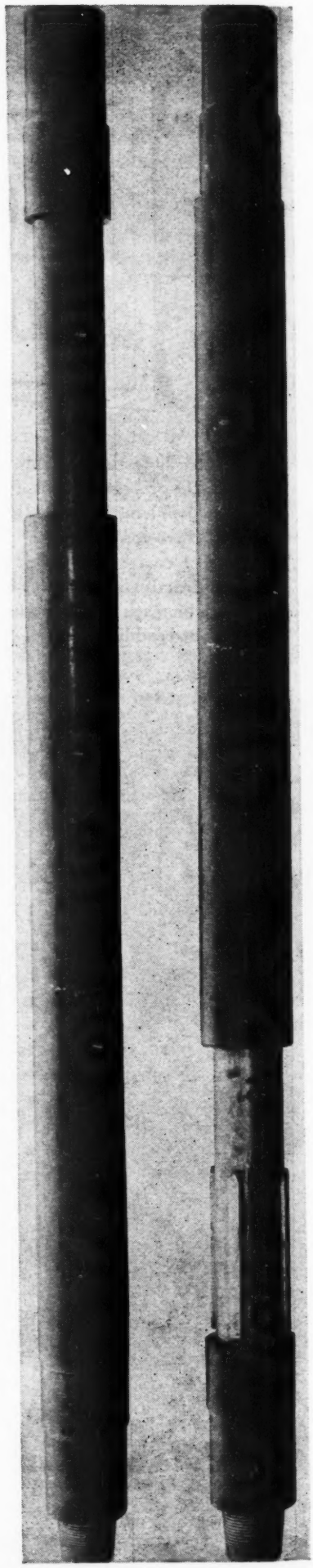
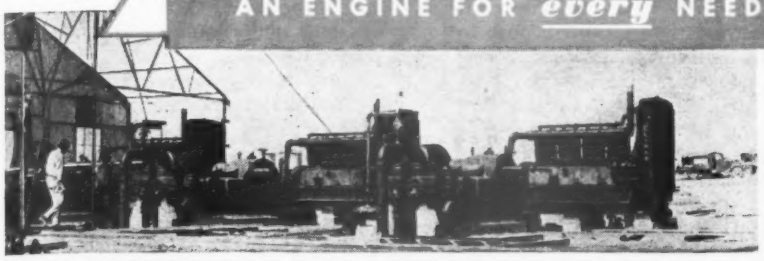


FIG. 1. ***Left:*** **the wiper in running position with the sleeve down on the spline and turning as an integral part of the drill stem.** ***Right:*** **Burris key seat wiper with sleeve on upper part of mandrel above the spline allowing the drill stem to turn as it would if the sleeve were stuck in a key seat.**

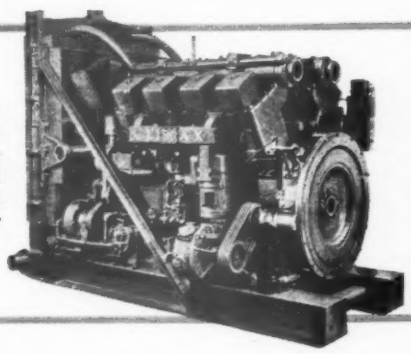
climax ...the *Complete* line of oil field power plants

AN ENGINE FOR *every* NEED!

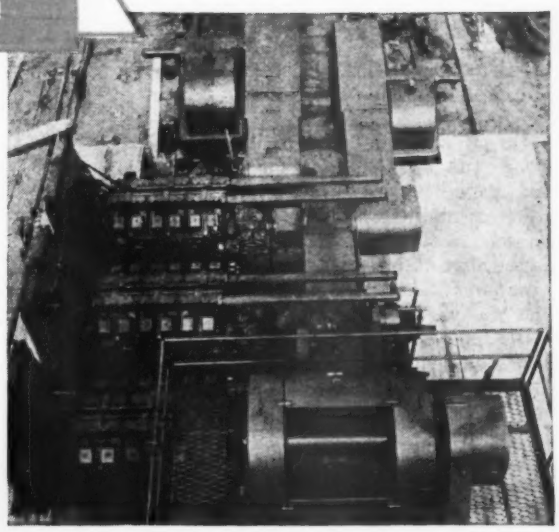


Pipe Line Pumping—R-225 eight-in-line engines deliver reliable power for pipe line pumping. These Climax engines have the stamina required for pumping service. Rated 210 h.p. at 1000 r.p.m. (complete power unit) for pipe line service.

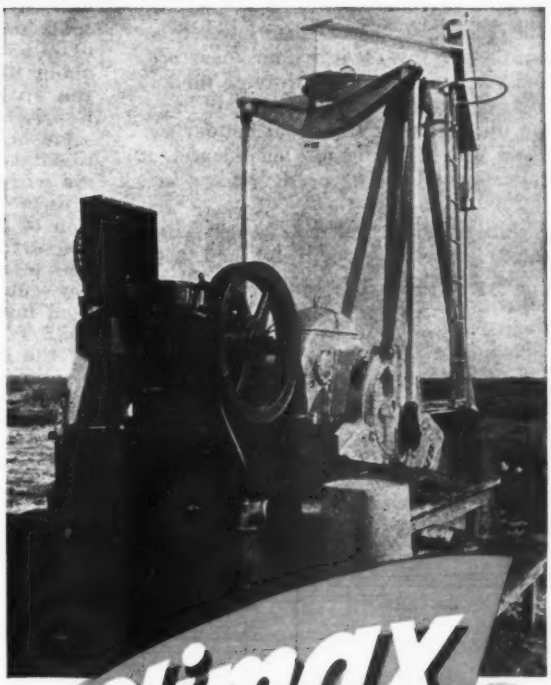
Slush Pump. R61 engine driving separate mud pump on drilling rig. A sturdy dependable engine for pumps, small rigs, etc. Rated 150 h.p. at 1050 r.p.m. as completely equipped power unit.



VU 280. 8 cylinders, 60° V-type. A rugged engine for hard, deep drilling and other heavy duty service. Rated 280 h.p. at 1100 r.p.m. with radiator, fan and other accessory equipment.



Deep Drilling—VU 420's get the hole down fast and at low cost. Plenty of power to hoist long strings of drill pipe quick—to drive big pumps—to cut your costs per foot drilled. Rated 420 h.p. (complete power unit) at 1100 r.p.m.



AT RIGHT: ***Oil Well Pumping***—Climax CSCO-66 oil well pumping engine. Quick starting—smooth running. Single cylinder simplicity plus modern refinements mean trouble-free operation of this 4-cycle engine with a minimum of attention. Rated 13 h.p. at 650 r.p.m.

■ For illustrated bulletins and complete specifications on these and other Climax Blue Streak Engines, showing the *many* applications for which each engine is suited, write Climax Industries, Inc., Climax Engineering Division, Clinton, Iowa. *Regional Offices: Chicago, Tulsa, New York.*

climax BLUE STREAK ENGINE

Builder of Climax DIESELS and GENERATING SETS

CLIMAX INDUSTRIES INC.

MID-CONTINENT DISTRIBUTOR
The Continental Supply Company
General Offices, Dallas

Climax Industries, Inc.,
Climax Industries Division
901 Sinclair Bldg., Ft. Worth, Texas

CALIFORNIA DISTRIBUTOR
Climax Engines & Parts Company
2050 Santa Fe Ave., Los Angeles

key seat wiper was pulled into this key seat with a strain of 20,000 lb. and knocked loose by lowering the drill pipe to allow the bumper sub to push down on the sleeve. The key seat wiper was then pulled into the key seat several times with a strain of 40,000 lb. and was freed each time by lowering the drill pipe and knocking the sleeve loose with the bumper sub.

● **Key seat wiper pulled into and through a key seat.** In order to stick the key seat wiper more firmly, a strain of 60,000 lb. was applied to force the key seat wiper into the key seat. This pulled the sleeve tightly into the wall, and it required about one-half hour to jar the sleeve loose.

During this time the drill pipe was lowered to a point where the spline was disengaged between the sleeve and the key seat mandrel, and the pipe was rotated freely, illustrating beyond a doubt that the sleeve of the key seat wiper was the only part of the drillstem that was stuck in the key seat.

It should also be mentioned that the pipe would not fall freely at a depth of 2300 ft. in this deviated hole, and very little jarring action could be applied to the sleeve.

After knocking the sleeve loose, the key seat wiper was worked upward through a total distance of 45 ft. of key seat by alternately pulling the sleeve of the key seat and rotating the drill pipe. The entire elapsed time was about 1 hr. and 45 min., including the time for testing, etc.

● **Key seat was apparently wiped out.** The drilling string was then lowered below the point where it first became stuck, and was pulled upward through the key seat area without any indication of hanging up. The next trip from bottom was made with no indication on the weight indicator of hanging up in the key seat at 2300 ft.

Until the time that the key seat wiper became stuck, the drill bit had been pulled after not more than 12 or 14 hr. of drilling, but it had been on bottom for about 24 hr. before the trip when it became stuck. The length of time of rotation on bottom, therefore, directly affects the possibility of becoming stuck in a key seat.

The second trip after the key seat wiper became stuck, another key seat was encountered at 2200 ft. The drillstem was worked upward through 25 ft. of key seat in 30 min. by alternately pulling the sleeve up into the key seat with a strain of 15,000 to 20,000 lb. and rotating the drilling string.

After this, the wiper did not become stuck until making a trip from a total depth of 6000 ft. when it became stuck at 3300 ft. This point was near the depth where the original hole was whipstocked to start the first sidetrack.

● **Wiper pulled through a key seat without rotating.** The wiper was worked through this key seat, but by a different method. The sleeve was first pulled into the key seat and then knocked loose by lowering the drilling string. This process was repeated several times without rotating the drilling string, and the key seat was soon wiped out.

The dogleg at 3300 ft. was not reamed at any time, and the key seat wiper did not become stuck in it until a total depth of 6000 ft. was reached. This indicates that the sleeve on the key seat wiper was keeping the dogleg in passable condition as it was pulled in and out of the hole.

It should also be noted that the key seat wiper first became stuck in the key seat at 2300 ft., which is the lowest point that the line reamer was used before being removed from the string. This gives some indication of the possibilities of key seats developing immediately below sections that have been reamed.

● **Key seats may be formed by reaming.** In this connection, reaming or underreaming a hole, especially a crooked one, is likely to cause key seats to develop immediately below the sections reamed or underreamed, due to leaving a projecting ledge.

Use of the key seat wiper on this well indicates that reaming of doglegs may be discontinued, and that some rig time may thus be saved.

● **First key seat wiper is in continuous service.** The first tool is in continual use in Sugar Valley field of Matagorda County where considerable key seat trouble had been encountered previously

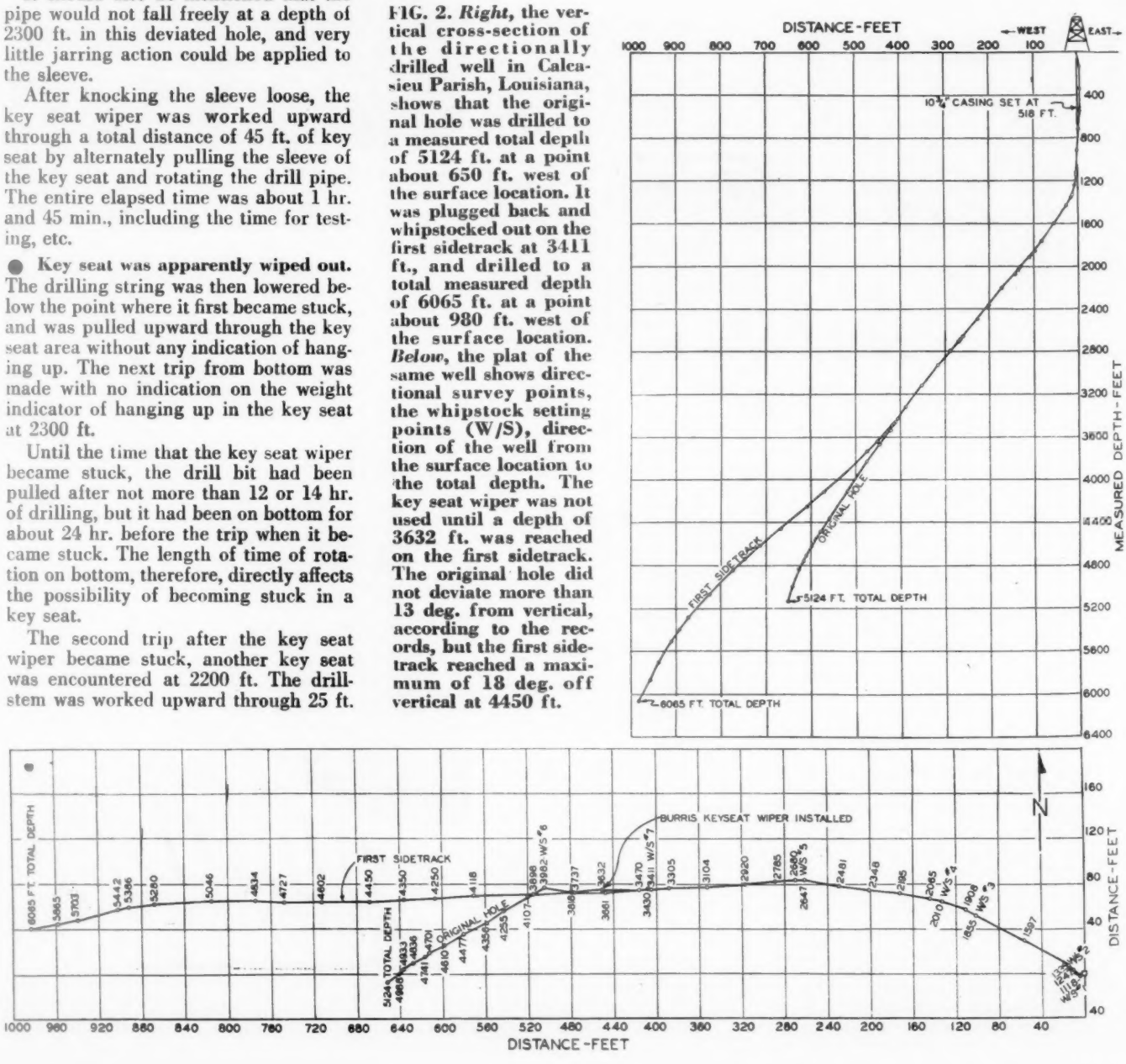


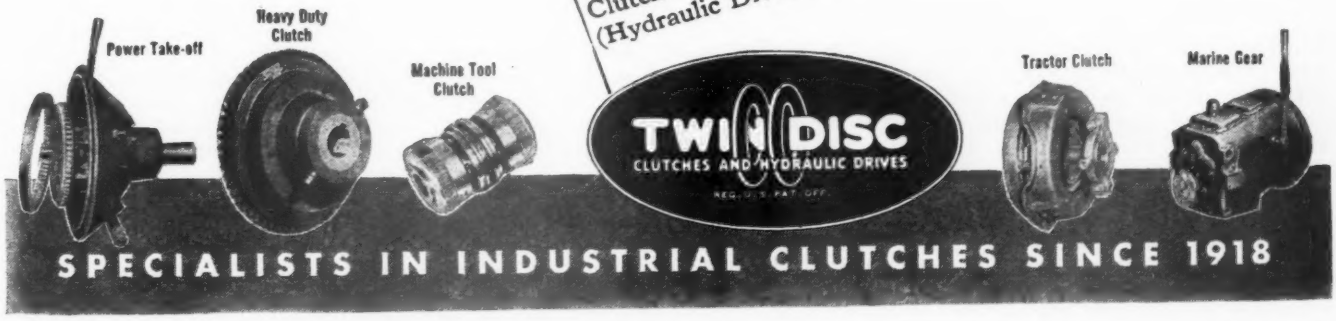
FIG. 2. ***Right,*** **the vertical cross-section of the directionally drilled well in Calcasieu Parish, Louisiana, shows that the original hole was drilled to a measured total depth of 5124 ft. at a point about 650 ft. west of the surface location. It was plugged back and whipstocked out on the first sidetrack at 3411 ft., and drilled to a total measured depth of 6065 ft. at a point about 980 ft. west of the surface location.** ***Below,*** **the plat of the same well shows directional survey points, the whipstock setting points (W/S), direction of the well from the surface location to the total depth. The key seat wiper was not used until a depth of 3632 ft. was reached on the first sidetrack. The original hole did not deviate more than 13 deg. from vertical, according to the records, but the first sidetrack reached a maximum of 18 deg. off vertical at 4450 ft.**

All the advantages of AIR OPERATION plus LONG WEAR-LIFE

Three compact, rugged Model P Clutches assure air operation plus long wear-life on this Emsco Model G-500 drilling rig. Model P Clutches are used for the rotary table drive clutch . . . master clutch . . . high speed drum drive clutch.

● All the advantages of air operation *plus* the *proved efficiency* and *long wear-life* of the Twin Disc Model EH friction disc type clutch is yours when you specify the Twin Disc Air-actuated Model P Clutch for your rig.

The Model P has the same duplex heavy-duty plates and large friction areas as the Model EH, which means less work per square inch of friction area and consequently less wear per square inch . . . greater torque capacity for any given shaft space . . . quick dissipation of heat. For efficiency and dependability, it will pay you to get all the facts on the Twin Disc Model P Air-actuated Clutch. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).



SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

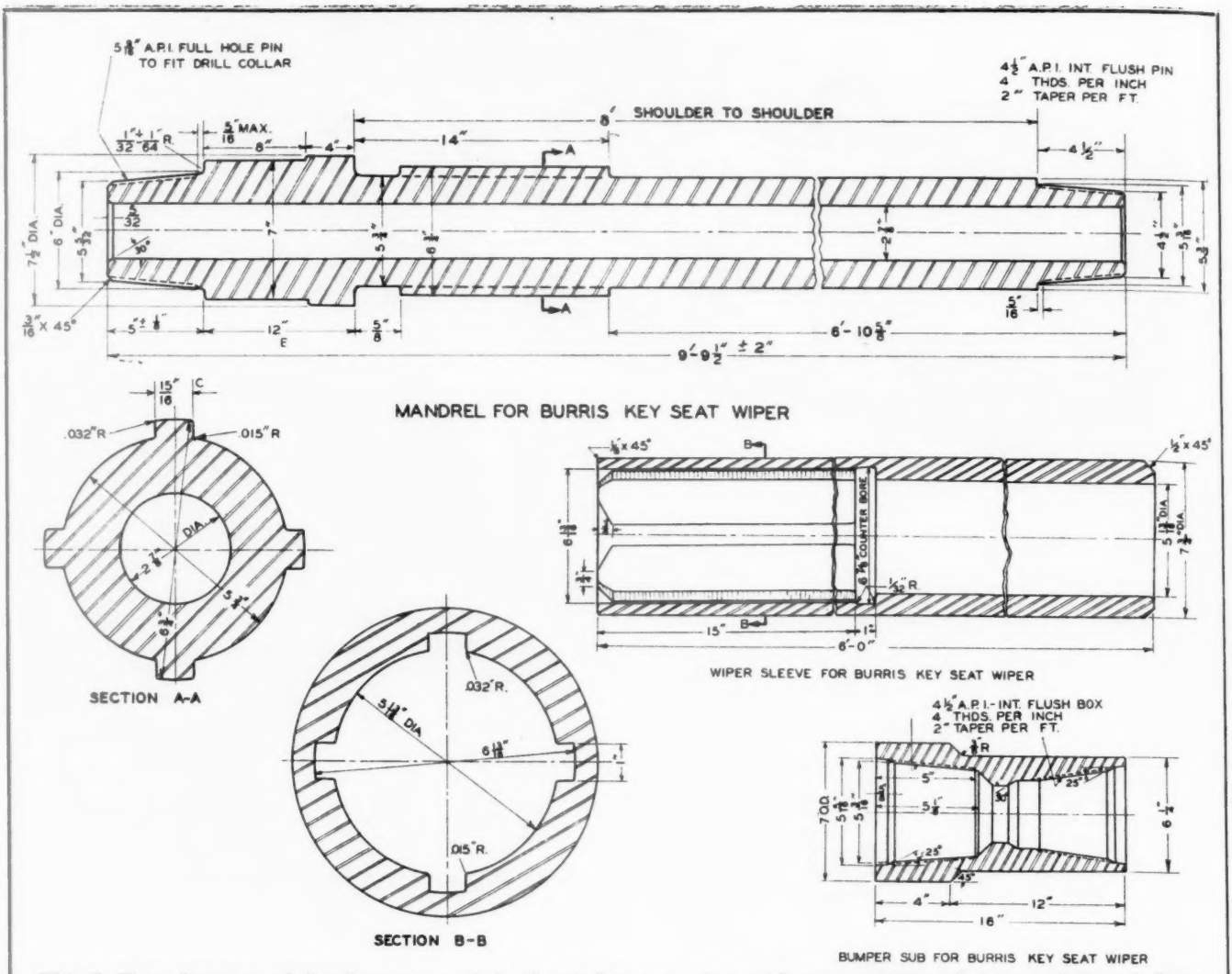

MANDREL FOR BURRIS KEY SEAT WIPER
SECTION A-A
SECTION B-B
WIPER SLEEVE FOR BURRIS KEY SEAT WIPER
BUMPER SUB FOR BURRIS KEY SEAT WIPER
SHOULDER TO SHOULDER
A.P.I. INT. FLUSH PIN
A.P.I. FULL HOLE PIN
TO FIT DRILL COLLAR
COUNTER BORE
A.P.I.-INT. FLUSH BOX

FIG. 3. Shop drawings of the three parts of the Burris key seat wiper with cross-sections of the mandrel and sleeve indicate the simplicity of the tool. The dimensions are for the tool that is designed to be used with 7-in. outside diameter drill collars. The sleeve is, therefore, ¾-in. larger in diameter than the drill collars, and has shown in the Calcasieu Parish well in Louisiana that it is sufficiently larger to keep the key seats free for upward passage of the drill collars. The dimensions, of course, will have to be altered for effective use of the tool with larger diameter collars.

in almost every well drilled. The tool in use in this field has completed one well to date and is close to the projected depth on a second well. No trouble in sticking in key seats has been encountered on these two wells.

The well in Calcasieu Parish is the first well, therefore, that definitely illustrates the usefulness of this new tool in drilling crooked or directional wells. Those familiar with the trials of this new tool believe it may become an effective tool to have on top of the drill collar whenever key seat trouble is expected.

The tool is now being used in a directional well in the Refugio field, in Southwest Texas. After the original well was dry on the downthrow side of a fault, a dogleg resulted from setting a whipstock at 4700 ft.

The well was drilled to a total depth of 6200 ft. without any indication of hanging up in key seats, but the whipstock setting resulted in a 90-deg. turn in the direction of well, and key seat trouble was indicated. After the key seat wiper was installed and had been in use several days, the drilling string was pulled out of the hole without indicating any key seat trouble on the weight indicator. The key seat wiper had apparently kept the hole free for upward passage of the drill collar.

● **Key seat wiper weighs about 1800 lb.** The weight of the tool for drilling 9⅞-in. hole is approximately 1800 lb. The drawings show the dimensions of the three parts of the tool. The inside diameter is 2⅞ in. This allows core barrels, etc., to pass freely through to the bit.

In the wells at Sugar Valley and Refugio, coring is done by using the core barrel on the bottom of the drill collar and the key seat wiper on the top of the drill collar. This reduces the possibility of the core barrel becoming stuck in a key seat.

It has been noted that use of the key seat wiper tends to maintain the direction of the directionally drilled wells. This is attributed to the fact that the sleeve acts as a stabilizer at the top of the drill collar, and will act as guide for the bit in drilling either directional or straight holes.

Another feature of tool is that the wear on the drill collar is minimized by being absorbed by the sleeve on the key seat wiper. The sleeve, however, is considered an expendable item of equipment. Either inside or outside wear on the sleeve of the key seat wiper can be renewed, thus keeping the top of the drill collar to the diameter desired. The design of the key seat wiper is such that it provides a somewhat flexible joint between the drill collar and the drill pipe. This tends to absorb the shock torque transmitted from the drill collar to the drill pipe during the drilling process and tends to prevent twist-offs of the drill pipe above the drill collar.

The sleeve of the key seat wiper is designed to have the maximum diameter that will allow washing over, in case it should be necessary to fish the tools out of a well. ★★★

OVER A HALF-MILLION FEET OF TUBING SURVEYED FOR CORROSION IN 4 MONTHS

with the OTIS TUBING CALIPER

That's right! In *only four months of operation* Otis crews have run the Otis Tubing Caliper through more than *107 miles* of tubing — surveying wells located in practically every Mid-Continent high-pressure area. And, as requests for Tubing Corrosion Survey Reports increase, Otis Pressure Control, Inc., continues to gain invaluable knowledge, heretofore unknown, in the study of tubing corrosion.

General interpretations of this new data and information, gained from factual compilations and study of the various types of corrosion found in 25 different fields, plus the extreme accuracy of the Otis Tubing Caliper, are available for practical application in every new survey being made. Many operators are expressing their confidence in the Otis Tubing Caliper by setting up regular schedules for periodic surveys in order to keep an accurate check on the progress of tubing corrosion.

The Otis Tubing Caliper is run under pressure on a steel measuring line by crews experienced in all types of wire line and pressure control operations. Operating quickly and efficiently on a mechanical direct-contact principle, the Caliper measures, and records on a metal chart contained in the barrel of the instrument, the extent and depth of corrosion penetration. Photostats of the charts (2200 feet per chart) plus a detailed analysis of each joint and tubing coupling are delivered, as a complete and comprehensive Tubing Corrosion Survey Report, to the operator within a few days.

Surveys require a minimum of time, expense, equipment, and personnel. If you would like to see an actual Tubing Corrosion Survey Report, contact Otis Pressure Control, Inc., 6612 Denton Drive, Dallas, Texas.

OTIS

T. M. REG.

OTIS PRESSURE CONTROL, INC.

TUBING CALIPER

C-3

FIELD OFFICES: TEXAS: HOUSTON, CORPUS CHRISTI, and LONGVIEW. OKLAHOMA: OKLAHOMA CITY. NEW MEXICO: HOBBS. LOUISIANA: NEW IBERIA

OTIS ENGINEERING CORPORATION — MANUFACTURE AND DEVELOPMENT

DISTRIBUTORS: OTIS PRESSURE CONTROL, INC., DALLAS, TEX.; OTIS EASTERN SERVICE, INC., BOLIVAR, N. Y.; WESTERN PRESSURE CONTROL, LOS ANGELES, CALIF.

Vapor lock in aircraft engines

By **WALLACE A. CRAIG**
The Fluor Corporation, Ltd.

THE AUTHOR

Wallace A. Craig has been in the oil or related industry since he received his degree in chemical engineering from Stanford University in 1922. He joined Vega Aircraft Corporation as a fuels and lubricants specialist in 1943 and represented that company and Lockheed on the Coordinating Research Council. Craig is now associated with The Fluor Corporation, Ltd., as a project engineer. He has patented a number of processes for gasoline treating and has written numerous articles dealing with connected subjects.

ONE of the "now it can be told" stories concerning the aggravations encountered during the war has to do with the problem of vapor lock in the airplane engines of some of our bombers and transports. The trouble appeared almost without warning and from then on occurred so frequently that it was deemed necessary to ground the offending ships while experiments were conducted to try to determine the cause of what was termed engine surging.

EXCLUSIVE

Early in 1943 it was observed that engine surging was occurring in a number of airplane models that were equipped with the larger engines. Surging comprised an unaccountable variation in the engine speed, the latter varying from 100 to 300 r.p.m. and frequently occurring periodically. In some instances these surges were sufficiently severe to cause engine cutting; i.e., failure or delayed re-starting. Vega (now Lockheed) Aircraft Corporation undertook to solve the problem, and called upon the Coordinating Research Council for help. They gave much valuable assistance in the flight tests, in the testing of the fuels used, and in the analysis of the data that were obtained.

During the summer of 1943 an extensive flight test program was carried out at Muroc Lake, California. The CRC sent a group of specialists drawn from the aircraft engine manufacturers, carburetor manufacturers, and the oil industry, to assist the flight crew and aircraft technologists from Vega in deter-

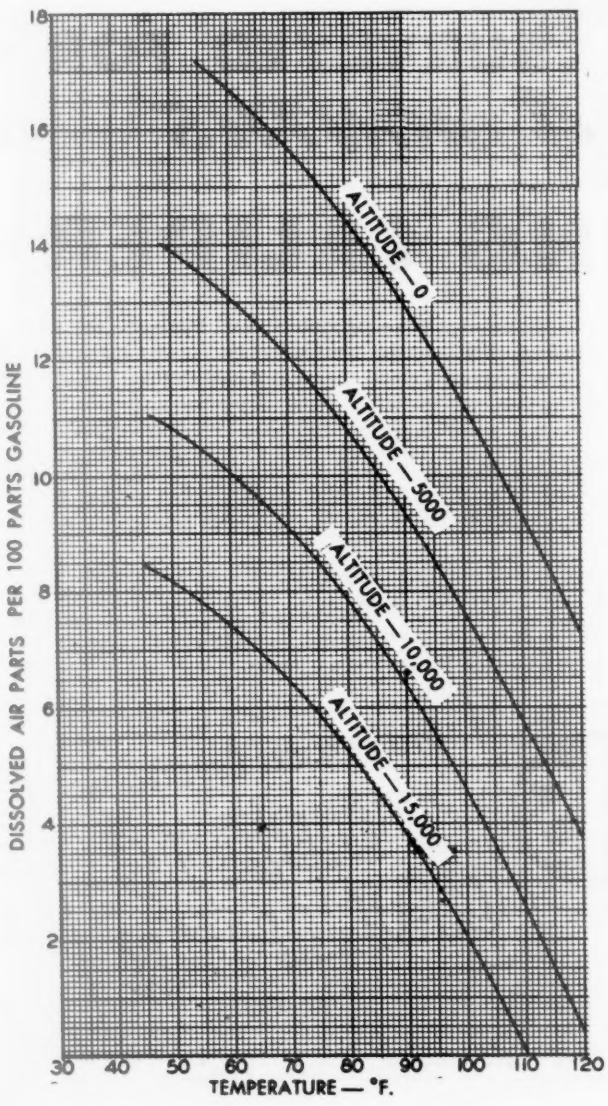
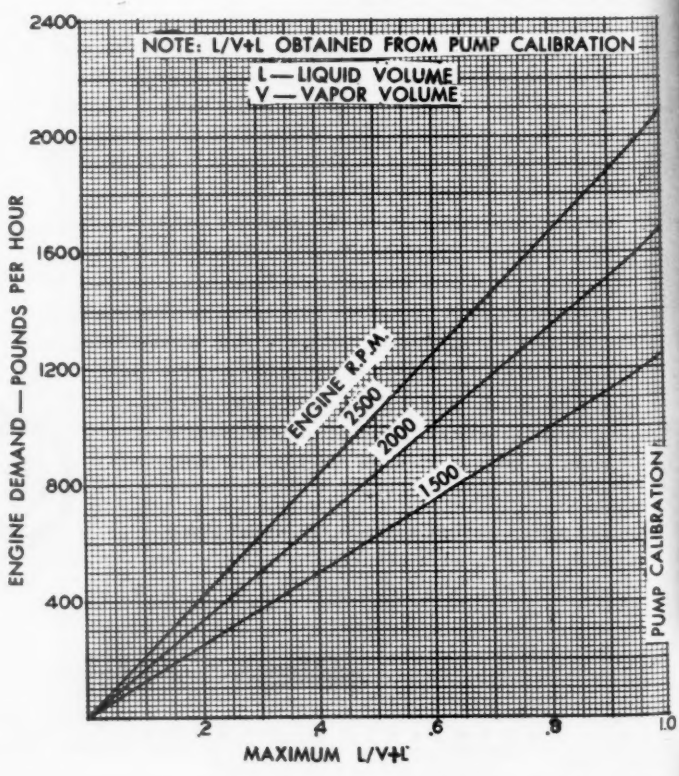
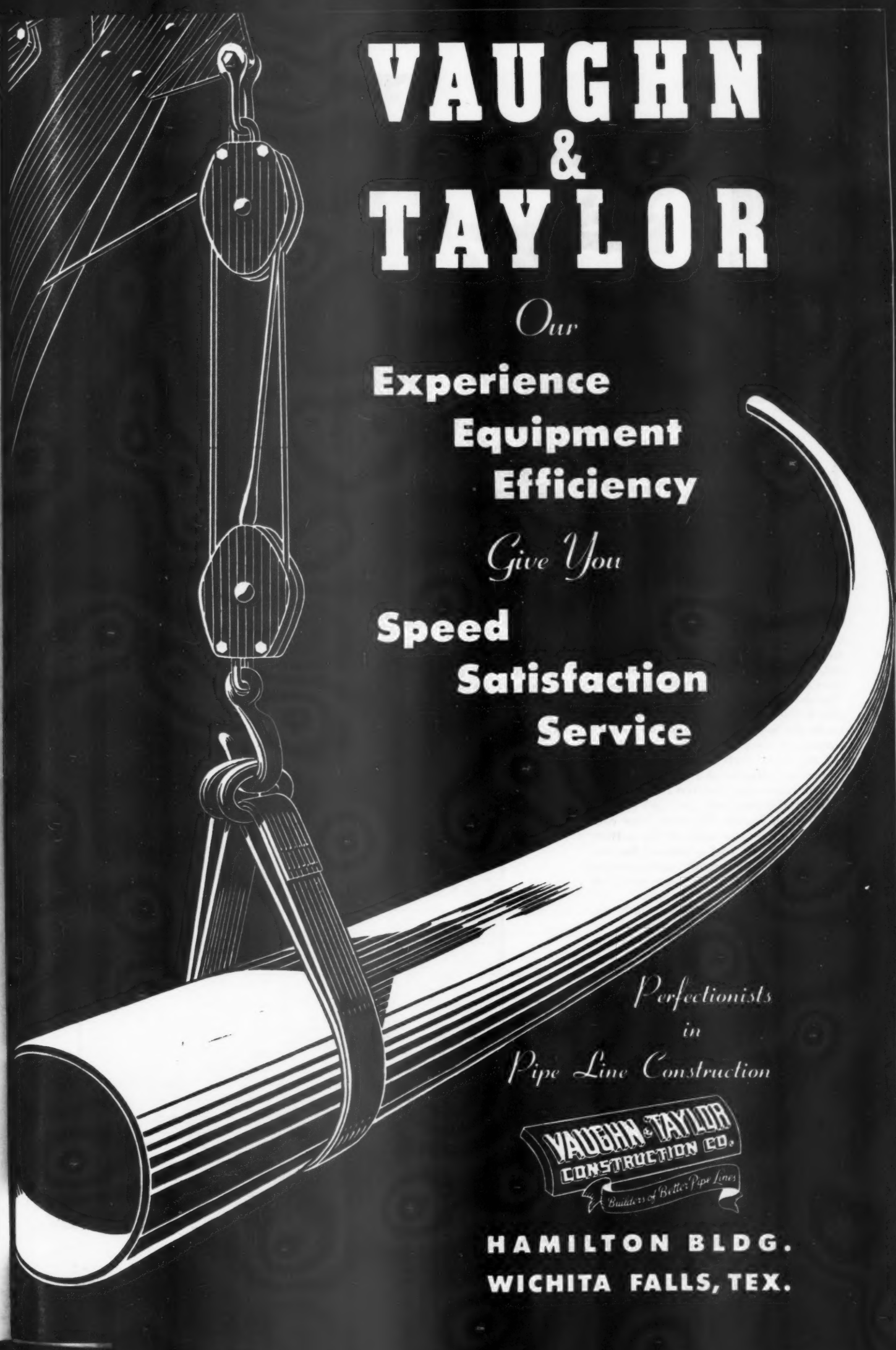


FIG. 1. Left—Air in solution at various temperatures and altitudes. Equilibrium conditions.

FIG. 2. Maximum tolerance of vapor for various fuel demands.





VAUGHN & TAYLOR

Our

Experience
Equipment
Efficiency

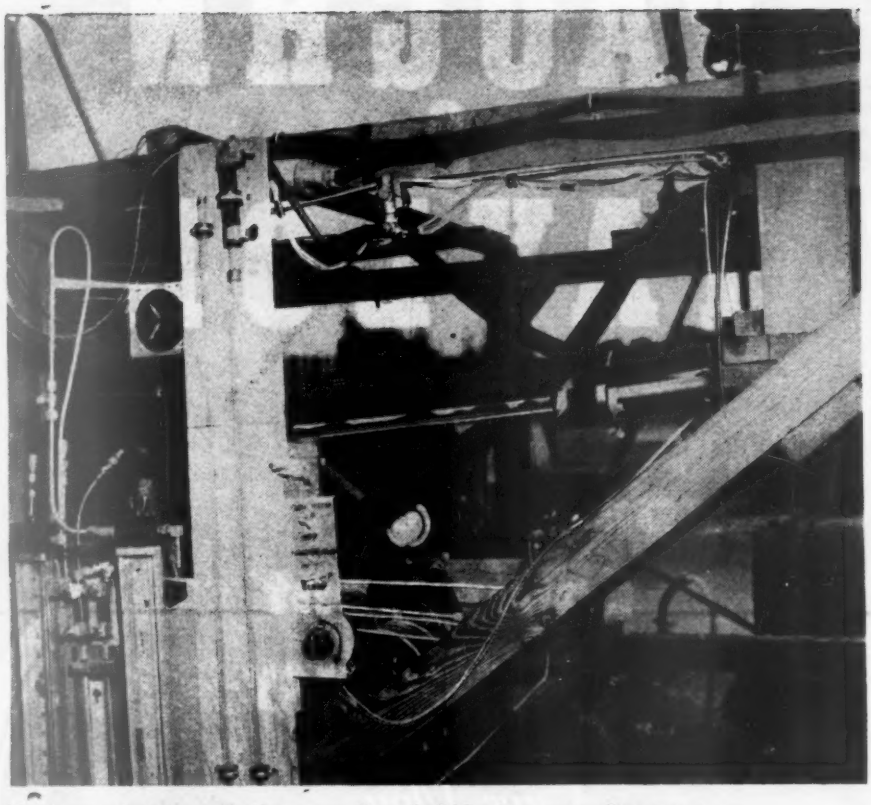
Give You

Speed
Satisfaction
Service

Perfectionists in Pipe Line Construction

VAUGHN & TAYLOR CONSTRUCTION CO.
Builders of Better Pipe Lines

HAMILTON BLDG.
WICHITA FALLS, TEX.



Mock-up of airplane fuel system. Note bubbles in suction line to pump.
Photo courtesy Lockheed Aircraft Corporation.

mining the basic causes of engine surging. The data that were assembled were later analyzed and the trouble diagnosed. The results of this work were made available to the various aircraft builders, who made the necessary changes to prevent surging in their own ships.

Early tests, both in flight and in the laboratory, eliminated a great many suspected causes and pointed the finger of guilt at the fuel and the fuel system. The tests at Muroc, therefore, were confined to an intensive study of this portion of the ship. The fuel system of the test airplane was thoroughly instrumented and several grades of fuel were provided with which to carry on the tests.

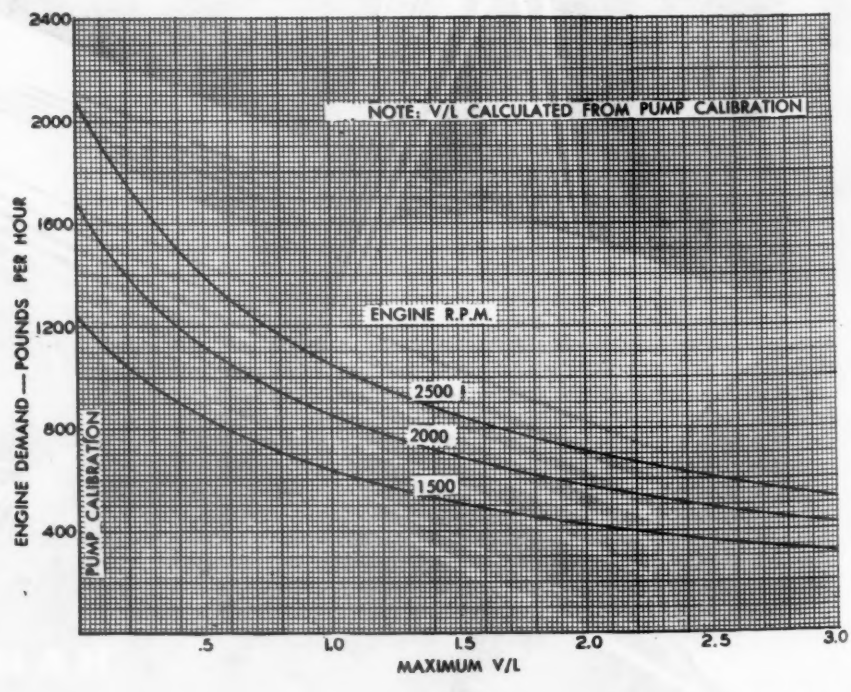
Inasmuch as the troubles usually appeared when cruising at altitudes of from 8,000 to 12,000 ft. and during the first hour or less of a flight, it was suspected that dissolved air in the gasoline played an important part in causing surging. In order to confirm this, numerous flights were made using gasoline that had been cooled and aerated and then heated carefully after loading, to prevent the loss of air by agitating the supersaturated fuel. In this way, a fuel was prepared that was charged with air and had characteristics similar to that of a freshly opened bottle of soda water. Surging of a minor nature was observed when using this technique. Later, flights were made, during which metered amounts of nitrogen were introduced into the fuel system in order to induce a vapor lock condition. The records obtained from these experiments were in close agreement with the calculated values of vapor volumes, which might be expected to cause surging.

Henry's Law tells us that the solubility of a gas in a liquid is proportional to the pressure of the gas above the liquid. It is possible, therefore, to determine the amount of air that is dissolved in gasoline at any pressure. By difference, it is possible to determine the amount of air that will be released from the gasoline when the pressure above it is reduced as, for example, in an airplane fuel system when the ship is climbing to higher altitudes.

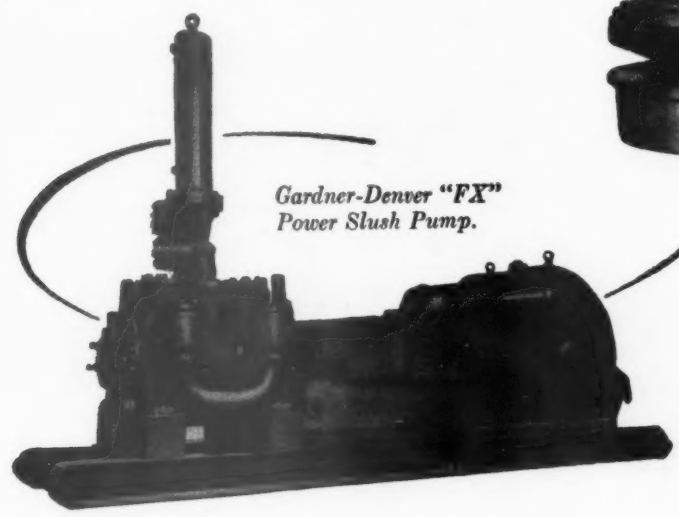
When the dissolved air is in equilibrium with the atmosphere above the gasoline, the amount in solution is as shown in Fig. 1. When the pressure is reduced, the air is released and expands until the sum of its pressure and the vapor pressure of the gasoline equal the total pressure under the new set of conditions. In a closed system this can be expressed as a ratio between the volume of vapor and the volume of liquid.

The main fuel pump of an airplane engine is operated by the engine itself and its speed is a function of the engine speed. It is necessary, therefore, to choose one sufficiently large that it will deliver the maximum demand at any engine speed. Obviously, at high engine speed the pump runs faster and delivery is greater. The required amount of fuel is metered by the carburetor and the excess capacity of the pump is bypassed from discharge to suction. If part of the material that the pump receives is vapor, however, its mass capacity is reduced, and if the capacity is reduced to a point where the engine demand cannot be met by the pump, look out! Hot lines and excessive pressure drop between the fuel tank and the pump will cause this to occur. Gasoline in liquid phase, which may or may not be supersaturated with air, will flow from the outlet of the tank toward the pump. The suction line is under reduced pressure; equilibrium conditions are disturbed and the turbulence within the line is sufficient to release the air and gasoline vapors. By the time that the gasoline reaches the pump, it is a heterogeneous mixture of vapor

FIG. 3. Maximum tolerance of vapor for various fuel demands.



"Slush Proof" Piston Rods, made of high-grade alloy steel, are case hardened at points of wear. They are ground on centers to provide absolute straightness.



Gardner-Denver "FX" Power Slush Pump.

"Slush Proof" Duo-Seat Valves have drop forged alloyed seat and bumper with renewable inserts.

"Slush Proof" Cylinder Liners are made from tubing drawn to our own specifications. Heat treated to maximum hardness, long service life is assured.

Protect the *Whole*
With Gardner-Denver *Parts*

You buy Gardner-Denver slush pumps for the extra service and stamina they will give you. Then be sure that the replacement parts you buy are also Gardner-Denver. Then—and only then—will you know that you can get the high measure of service which makes Gardner-Denver pumps leaders in their field.

All Gardner-Denver replacement parts provide maximum resistance to wear. They are precision made. They fit accurately and are easy to install. It *pays* to insist on Gardner-Denver.

Gardner-Denver Company, Quincy, Illinois • Dallas • Houston • Tulsa • St. Louis • Los Angeles • San Francisco • Denver New York • Chicago • Pittsburgh • Continental Supply Co., Continental Bldg., Dallas, Texas • Republic Supply Company (of California), 2122 E. 7th Street, Los Angeles, California

GARDNER-DENVER *Since 1859*

Test pilot and flight engineer preparing for test flight.

—Photo Courtesy Lockheed Aircraft Corporation.

and liquid. The pump gets a gulp of gasoline and a gulp of vapor; the bypass valve starts to close to allow more gasoline to go to the carburetor. Finally the bypass is completely closed and there is still not enough gasoline to meet the engine demand and the latter slows down. This reduces the speed of the pump and the pressure on the suction side rises and less vapor is produced. A greater mass of gasoline then passes from the pump to the carburetor and the engine speed again increases. This cycle of operations may occur within a second or two and repeat itself rhythmically, from which comes the name "surging".

If one knows the capacity of the pump and the engine demand at a given speed, the maximum amount of vapor that can be tolerated can be computed. This is shown graphically in Figs. 2 and 3. Having established the maximum V/L limits that can be tolerated by the engine, it is necessary to examine the fuel and the fuel sysem to determine the conditions under which excessive V/L ratios may be found, and what corrections must be made to keep them within safe limits. The conditions of the gasoline within the fuel tank can be estimated closely. For instance, if the airplane has been fueled from an underground tank during a cool portion of the day, the air content will approximate that calculated under equilibrium conditions at ground elevation and the storage temperature. During flight, the air is desorbed slowly unless the gasoline is vigorously disturbed, and the "soda water" phenomenon will persist for a number of hours, bubbles slowly forming and being expelled through the tank vent but not sufficiently fast to approach equilibrium. Once the gasoline enters the fuel system, it is agitated sufficiently to release the air, but the latter cannot escape and must pass through the fuel lines along with the liquid gasoline.

In order to demonstrate the use of the charts in analyzing a condition within the fuel system, let us assume the following conditions:

Altitude at start of flight—0 (760mm)

Initial fuel temperature—65°F.

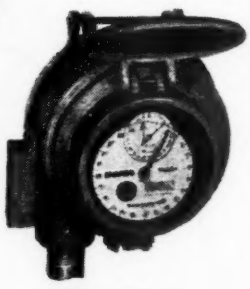
like another **FAITHFUL** *employee!*

ENARDO *clock controlled*

VALVES...SWITCHES

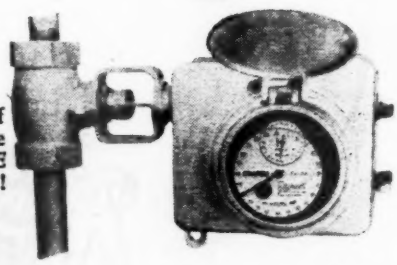
CLOCK-CONTROLLED MERCURY-TUBE SWITCH

To-the-minute control on engines, motors, lights through accurate hand-wound clock mechanism. Turn-on or shut-off control up to 11 hours or 22 hours according to the model. *ONE* TRIP FOR THE OPERATOR, BUT *TWO* OPERATIONS!



CLOCK-CONTROLLED TIME-CYCLE CLOSE-IN VALVE

Automatic, high-pressure shut-off control when you want it—non-shock closing to eliminate strain to well equipment and flow lines. Manually opened by hydraulic pump action. *ONE* TRIP TO THE WELL, *TWO* OPERATIONS!



CLOCK-CONTROLLED SHUT-OFF VALVE

Engine fuel gas shut-off predetermined and exact. Shut-off control by separate spring assures accuracy and positive control. Cases are tamper, dirt, and moisture-proof! *ONE* TRIP FOR THE OPERATOR, *TWO* OPERATIONS!

SEND FOR BULLETIN DEPT. 10-P

ENARDO *Foundry and Mfg. Co.*

TULSA, OKLA.

TWO FAMOUS "VULCAN" VISES

Built for your toughest oil field and refinery jobs, these rugged, drop-forged vises will provide long, dependable service. Two types to choose from:

"VULCAN"—the *original* Chain Pipe Vise . . . unbreakable, light, compact, positive in action. Made entirely of tough wrought steel with drop-forged base, handle and jaws. Teeth are saw-tempered for file sharpening. 4 sizes for pipe 1/8 to 8".

"VULCAN SUPERIOR"—an improved Vise featuring *Overhead Adjustment Handle*, making it easier and faster to use. Jaws are reversible, providing double the service of conventional vises. Larger capacity — each vise takes pipe 1/2" larger than other chain pipe vises of similar size. Supplied in two sizes for pipe, 1/8 to 4-1/2". Sold by leading Oil Field Supply Stores. J. H. WILLIAMS & CO., Buffalo 7, New York.

WILLIAMS
DROP-FORGINGS AND DROP-FORGED TOOLS

Altitude of flight — 15,000 ft. (429 mm.)

Fuel temperature at pump—75°F.

Pressure drop from tank to pump—60 mm.

Fuel demand by engine—1200 lb. per hr.

Engine speed—2000 r.p.m.

$$V/L = \frac{A \times [(P_1 - P_2) - (p_{g1} - p_{g2})] \times 760 \times T_2}{100 \times P_2 - p_{g2}) \times T_0}$$

Where:

- A = solubility constant to give air per 100 parts of gasoline,
- P_1 = initial pressure,
- P_2 = pressure at test conditions,
- p_{g1} = initial vapor pressure of gasoline (from Fig. 5),
- p_{g2} = vapor pressure at test conditions (from Fig. 5),
- T_2 = temperature at test conditions in °F. abs., and
- T_0 = reference temperature (32°F. equal to 492°F. abs.)

Our equation then becomes:

$$V/L = \frac{0.028 \times [(760-369) - (180-220)] \times 760 \times 535}{100 \times (369-220) \times 492}$$

$$V/L = 0.67$$

From Fig. 3, we find that the maximum V/L that can be tolerated is 0.4. Conditions are such, therefore, that the pump cannot deliver the required amount of fuel and the engine will not operate satisfactorily.

Now, suppose that the fuel in the tank is brought to equilibrium at the flight altitude. Conditions will then be as follows:

Initial pressure—429 mm.
Initial temperature—65°F.
Fuel temperature at pump—75°F.
Pressure drop to pump—60 mm.
Fuel demand—1200 lb. per hr.
Engine speed—2000 r.p.m.

$$V/L = \frac{0.028 \times [(429-369) - (180-220)] \times 760 \times 535}{100 \times (369-220) \times 492}$$

$$V/L = 0.155$$

The V/L ratio has now dropped below the danger limit of 0.4 and the engine will operate satisfactorily. A typical plot of constant V/L ratios and the influence of temperature and pressure changes is shown in Fig. 4.

The final step in the solution of the problem was to develop a satisfactory way to bring the gasoline to equilibrium with respect to the air dissolved therein. One method that has proved to be quite satisfactory is to install a submerged centrifugal pump in the bottom of the tank to supplement the engine pump. One make of pump is provided with a small stirring paddle that agitates the gasoline within the tank to such an extent that the air is released before entering the fuel lines and escapes from the tank vent. The pump suction is flooded at all times, and once the gasoline is discharged into the fuel lines the pressure is maintained sufficiently high that no further vaporization will take place until it passes through the carburetor.

★★★

FIG. 4. Vaporization characteristics of aviation gasoline.

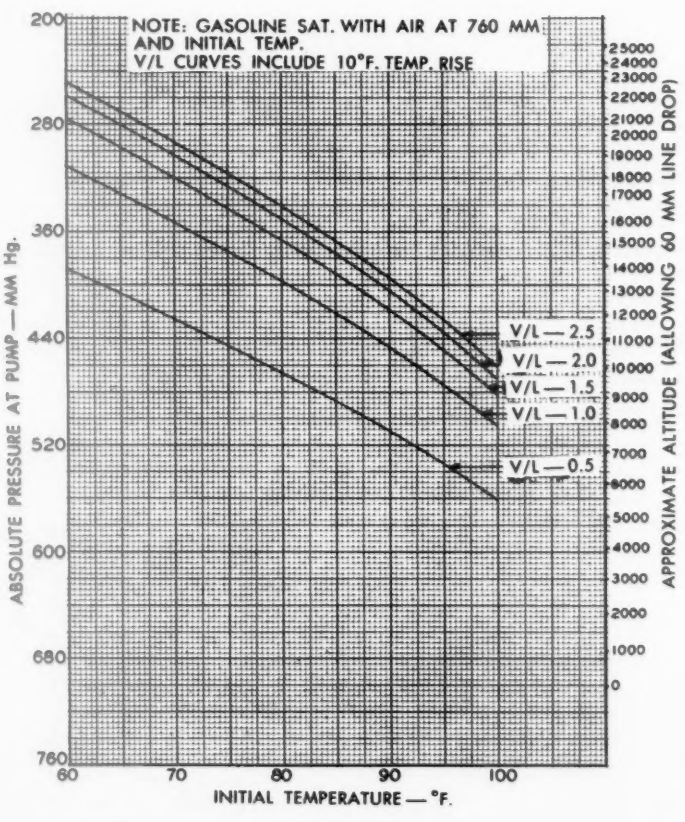
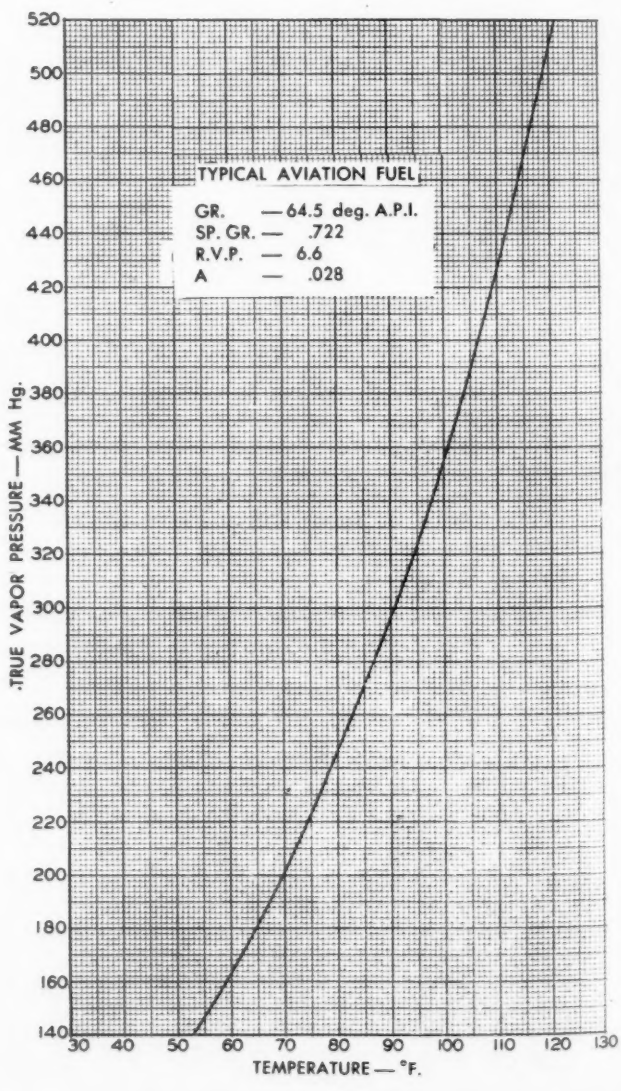

NOTE: GASOLINE SAT. WITH AIR AT 760 MM AND INITIAL TEMP.
V/L CURVES INCLUDE 10°F. TEMP. RISE
V/L — 2.5
V/L — 2.0
V/L — 1.5
V/L — 1.0
V/L — 0.5
ABSOLUTE PRESSURE AT PUMP — MM Hg.
APPROXIMATE ALTITUDE (ALLOWING 60 MM LINE DROP)
INITIAL TEMPERATURE — °F.

FIG. 5. Vapor pressure vs. temperature.

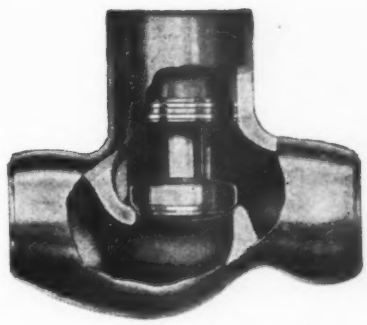


PIPING FLEXIBILITY *with* Edward *Check Valves*

FOR large, medium or small lines . . . for horizontal, vertical or angle installations . . . for 150 lb to 7500 lb service . . . stainless steel or Stellite trim . . . whether you need flanged, screwed or welding ends—there is an Edward steel check valve to meet your requirements. Many sizes and types are in stock for immediate shipment.

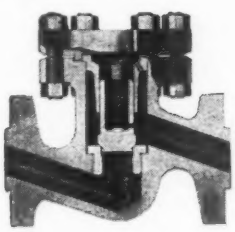
BIG CHECKS

Vibration, clatter and damaging shock to piping are eliminated with Edward piston-type check valves. Integral guide ribs, cored out for free flow, guide the hourglass disk-piston throughout travel to prevent hanging up. New flow contours reduce pressure loss, increase operating efficiency. Built in sizes through 14 in.

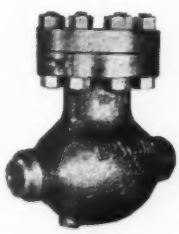


AVAILABLE IN HORIZONTAL ~ . . . ANGLE ⌜ . . . VERTICAL |

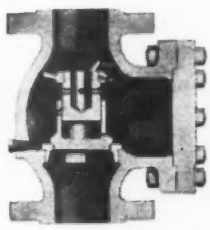
MEDIUM



Exclusive Edward disk guide lip aids tight seating and cuts wear on seat and disk through momentary throttling action.



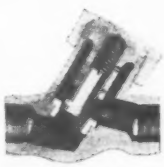
Edward check valves may be disassembled without removing from the line. Covers are forged steel.



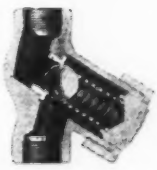
AVAILABLE IN HORIZONTAL ~ . . . ANGLE ⌜ . . . VERTICAL |

SMALL

Edward forged steel check valves are spring loaded to insure quick, accurate seating. Bodies are streamlined.



For viscous fluids or hydraulic service, Edward ball checks are ideal. Stainless steel ball is mated to seat.



Design of small Edward checks permits use in either horizontal or vertical lines. Built in sizes down to ¼ in.

AVAILABLE IN HORIZONTAL ~ . . . ANGLE ⌜ . . . VERTICAL |

A request on your company letterhead will bring you an Edward Catalog.

ROCKWELL E V

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO EAST CHICAGO, INDIANA

Running Tour WITH MEN IN THE INDUSTRY

● **E. R. "Ray" Poole,** manager of Foreign Service Department for Security Engineering Co., Inc., returned from a six and one-half months' business trip in South America where he visited every oil producing country on that continent. After a short stay in the States, he will return to South America where he will take up residence in Barranquilla, Colombia. From there he will make regular visits to all of the South American oil fields, giving aid and assistance in the proper uses of Security Engineering Company, Inc., products.

E. R. "Ray" Poole

● **H. A. Grebe and E. P. Doremus,** recently associated with the J. S. Abercrombie Company in the capacity of superintendent and chief chemist, and process engineer, respectively, of the Old Ocean Refinery, have established consulting services for refinery and light hydrocarbon processes. Headquarters are at 919 Fannin Street, Room 36, Houston, Texas. Prior to his association with Abercrombie, Grebe was with The Texas Company for 14 years. Doremus formerly was with Shell Oil Company, Inc., in research and development, and the University of Houston as instructor in petroleum refining.

● **Robert M. Briggs,** president of The Mayhughben Company, Dallas, Texas, independent operators, died September 21 in Santa Fe, New Mexico, where he had gone for the summer. Death followed several months' illness. He was 54. Briggs was a charter member of the Independent Natural Gas Association of America, also a member of the American Petroleum Institute and of the Independent Petroleum Association of America. He belonged to the Dallas Petroleum Club and to the Dallas Athletic Club. He took his prep school training at Bordentown Military Institute in Bordentown, New Jersey, and was a graduate of Vermont University, holding a B.S. degree in civil engineering. He is survived by his widow and two sons, Hugh M. Briggs and Ben R. Briggs of Dallas, who were with him at the time of his death; also his mother, Mrs. B. C. Briggs of Fort Worth, Texas.

● **Edward L. Carter,** export sales representative for the Shaffer Tool Works, Tulsa Boiler and Machinery Company, W. C. Norris, Manufacturer, Frank Wheatley Pump and Valve Manufacturer, Ben F. Kelley Company, and the Air Operated Slip Division of the McEvoy Company recently visited the operating fields in Venezuela, and will return in October.

● **R. G. Follis,** president of the Standard Oil Company of California, flew to Venezuela the middle of September to inspect oil operations at the company's concessions. Accompanying Follis was **R. C. Stoner,** vice president and director in charge of production, and it was stated that they hoped to assess the future prospects of the concessions. President Follis also discussed before his departure, the company's operations in the Middle East. Political disturbances there, he said, had not changed the company's plans for building a pipe line to carry Saudi Arabian oil to the Mediterranean. Discussing domestic operations, Follis said the demand for gasoline on the west coast had been unprecedented, and that for the present the company had no California gasoline to ship to its normal east coast distributing center. For the present, Standard of California is refining in its east coast facilities, obtained in the recent deal with Barber Asphalt, crude oil purchased in the Texas Gulf Coast area, and has no immediate plans for major expansion in the East.

● **Arthur P. Shanklin** has been made vice president and general sales manager of Carrier Corporation, it is announced by **Edward T. Murphy,** senior vice president. He is in charge of all domestic sales activities. A vice president of Carrier Corporation since 1941, Shanklin has been associated with the company since his graduation from the University of Kentucky in 1922. During this period he has served in many sales and executive capacities and recently has been vice president in charge of dealer sales.

● **William A. Baker** has joined Shell Pipe Line Corporation as vice president and treasurer, it is announced by **T. E. Swigart,** president. Baker brings 25 years of field and administrative experience with Shell Oil Company to his new post. He has been assistant treasurer of that concern since he went to Houston six years ago. Previously, he served seven years as its comptroller in St. Louis, after 12 years in its Pacific Coast operations.

● **Herman J. Woehrmann** has been named assistant purchasing agent for Shell Pipe Line Corporation, according to an announcement by **H. H. Anderson,** vice president. **Frank H. Jones** was named chief clerk and buyer of the company's purchasing and stores department to fill the vacancy created by Woehrmann's appointment, Anderson said.

Shell Pipe Line's purchasing agent is **J. B. Thompson,** who served during the war emergency on the Houston staff of the Petroleum Administration for War. Both Woehrmann and Jones for some time have been acting in their new positions, first because of Thompson's absence and later because of the extended illness of **E. H. Lindesmith,** Thompson's previous assistant, who died September 17.

● **W. C. "Bill" Johnson** has been made sales representative in the oil field area comprising Louisiana, Southern Arkansas, Mississippi, and points in Alabama and Florida, by John A. Roebling's Sons Company, it is announced through R. A. Hill, Houston branch manager. Johnson, who served with the U. S. Navy for 41 months, is well-qualified for his new duties, having been active in the oil field trade since 1928.

W. C. Johnson

● **James P. Cunningham,** vice president in charge of production of Luscombe Airplane Corporation, Dallas, Texas, has been elected to the board of directors of Luscombe, **L. H. P. Klotz,** president, announced. Cunningham joined Luscombe in 1942 as a member of the tool design department. In 1943 he became chief production engineer and, in 1945, he was advanced to factory superintendent. He was appointed vice president in charge of production in April of this year.

● **E. W. McAllister,** well known petroleum engineer of Los Angeles, where he has been employed for a number of years by Western Gulf Oil Company, and has been especially active in the gas condensate plant at Paloma, has been transferred to London, England. There he will be assigned the position of chief petroleum engineer for the Kuwait Oil Company, Ltd., in which Gulf Oil Corporation and Anglo-Iranian Oil Company are jointly and equally interested.

● **V. H. Peterson,** manager of the Railroad Division of Fairbanks, Morse and Company, announces the appointment of **James G. Graham** as district manager of the division, with headquarters in Chicago.

● **James R. Reed** has been named manager of the commercial research department of the Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, according to an announcement by J. L. Singleton, manager of district offices for the company. Other department appointments announced are those of **Jerome F. Fitzsimmons** as supervisor in charge of research and **Anson J. Bennett, Jr.,** as supervisor in charge of sales analysis.

● **J. E. Fifield,** formerly with the U. S. Naval Research Laboratory and the American Brake Shoe Company, has joined the Development and Research Division of The International Nickel Company, Inc. He will make his headquarters at the New England Technical Section of the division at 75 Pearl Street, Hartford, Connecticut, of which **D. A. Nemser** is manager.

● **H. S. Brown,** chairman of the board and president of Foster Wheeler Corporation, has been elected a director of Liberty Mutual Insurance Company.

● **Homer W. Derby** has been appointed works accountant of General Electric's new laminated plastics factory at Coshocton, Ohio. Derby has been serving in a similar capacity at the Lynn plastics factory, which is in the process of being transferred to Coshocton.

● **A. J. Komich,** who was recently discharged from the U. S. Navy with the rank of lieutenant-commander, has been appointed to the New England sales staff of the Pittsburgh Equitable Meter Division, Rockwell Manufacturing Company. He will work from the Boston, Massachusetts, office under the direction of **F. C. Arens,** district manager. Komich is a native of Medford, Massachusetts, and a graduate of the engineering school at Northeastern University. Prior to the war he was associated with the Worthington Pump and Machinery Company. He will represent the company in the states of Massachusetts, Maine, New Hampshire, and Vermont. He will handle the sale and service of meters for gasoline, oil, and industrial applications.

SO YOU CAN HAVE

More Power

COOKTITE SEALING RINGS

IT'S really quite simple. Just replace several plain rings with Cooktite Sealing Rings—you've permanently sealed the combustion pressures — eliminated blow-by — obtained more power.

Cooktites have been doing this for Diesel and gas engine operators ever since they were first introduced in 1930. Moreover when you eliminate blow-by, cylinder lubrication is improved—there is less accumulation of carbon in the compression ring belt—less ring sticking—operation generally is bettered.

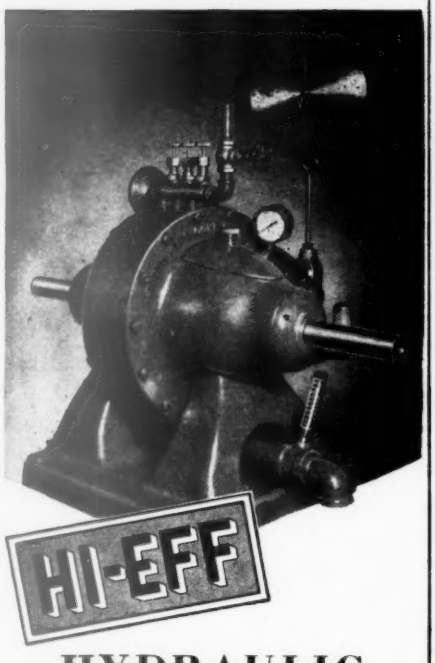
You see the Cooktite has no gap openings—and it functions throughout its life as a gapless ring.

Order Cooktites now to be installed when next you pull pistons—and specify new engines be Cooktite equipped. It's the proven way to get MORE POWER.

Sealing Pressures Since 1888

C. LEE COOK MANUFACTURING CO.
INCORPORATED
LOUISVILLE, KY.

BALTIMORE • BOSTON • CHICAGO • CLEVELAND • HOUSTON • LOS ANGELES • MOBILE • NEW ORLEANS • NEW YORK • SAN FRANCISCO • TULSA



HYDRAULIC DYNAMOMETERS

- *EFFICIENT*
- *ECONOMICAL*
- *COMPACT*

You can depend on the performance data taken off a "HI-EFF" hydraulic dynamometer. All frictional and torque losses, except of cradle bearing, are measured on the scale, giving an accuracy approximately 99.7% perfect. This high degree of accuracy is maintained with all capacities to 6,500 H.P.—speeds to 25,000 R.P.M.

Considering the low initial cost, minimum maintenance expense and small floor space required, you can have "HI-EFF" accuracy at cost savings that will surprise you. There are 72 different capacity models available from standard patterns. Write for complete details. Taylor Manufacturing Co., 3046 West Meinecke Avenue, Milwaukee 10, Wis.

TAYLOR OF MILWAUKEE

"HI-EFF" Hydraulic Dynamometers
Static Balancing Machines
Sensitive Drilling Machines

● **Leonard W. Beck** was appointed acting general sales manager of the Cummins Engine Company, Inc., it is stated by R. E. Huthsteiner, vice president, assistant general manager and controller. Beck's new responsibilities will be the overall administration of the distribution division (sales and service).

L. W. Beck

Although Beck will continue as manager of the company's central region, his offices will be at the factory in Columbus, Indiana. Beck has been with the Cummins Diesel organization since 1938, and, prior to his new appointment, was manager of the central region, with offices in Chicago, a position to which he was appointed in 1939.

Byron A. Duling, manager of the Cummins Engine Company's Cleveland Region, has been assigned to the home office to work directly under Beck.

Huthsteiner also has announced the appointment of Corwin B. Briscoe as acting parts merchandising manager at Columbus. Briscoe recently joined Cummins after a tour of duty in the South Pacific as a lieutenant commander in the U. S. Navy. Other appointments are Norman E. Palmer as the Cummins representative in Washington, D. C., and Fred W. Sparks as manager of the Cleveland region. James D. Allen continues as sales manager of dealer operations at Columbus, and Kenneth M. Leech as service manager at Columbus.

● **John C. Gregory** has been named assistant treasurer of The Atlantic Refining Company. He has been employed by the company since 1929 when he was graduated from the University of Pennsylvania.

● **J. F. Borthwick, Jr.,** chemical engineer, of Hattiesburg, Mississippi, has joined the engineering staff of the Mississippi Oil and Gas Engineering Committee at Jackson. Borthwick has been in the employ of the Mississippi State Oil and Gas Board as field representative since oil was discovered in Mississippi in September, 1939, except for a period of 24 months when he served with U. S. Marine Corps in the South Pacific.

● **L. G. Schraub,** vice president and general manager, has been elected to the board of directors of Union Wire Rope Corporation, 21st and Manchester, Kansas City.

● **Kenneth Austin,** financial writer for *The New York Times,* has joined the public relations staff of the United States Steel Corporation, it is announced by **J. Carlisle MacDonald,** assistant to chairman of the board of directors. Austin, who joined the staff of *The Times* in Paris in 1925, for many years has handled news of the steel industry for his newspaper.

● **W. T. Holliday,** president, The Standard Oil Company (Ohio), has announced the election of **Clyde T. Foster,** vice president in charge of finance and accounting, as a director of the company and the appointment of **Elliott B. McConnell** as vice president in charge of manufacturing and his election as a director. Foster succeeds **William J. Semple** as director. Semple has retired after an association with the company of nearly 20 years. McConnell, who has been general manager of the manufacturing department, succeeds **George W. Hanneken** who retired September 1.

● **Winthrop Rockefeller,** recently discharged from the Army with the rank of lieutenant colonel, has joined the staff of the producing department of Socony-Vacuum Oil Company, Inc., it is announced by **B. Brewster Jennings,** president. Rockefeller has just completed a report, requested by the secretary of war, on veterans' adjustment problems. This report, based on a six-month nation-wide survey of veterans and their problems, includes not only an exhaustive study of veterans' conditions, but also a series of recommendations for improvement of the rehabilitation of returned servicemen.

● **Charles O. Strahley,** manager of The Texas Company's personnel department since 1942, died last month at his home in Jamaica, Long Island. Born in 1888 in Cincinnati, Ohio, Strahley began his business career as night telephone operator at the Cincinnati Bell Telephone Company. In 1910 he entered the employ of the Indian Refining Company as a stenographer in the purchasing department. He went to New York when the Indian Refining Company moved to that city, and in 1912 entered the service of The Texas Company as a stenographer in the marine department.

● **Harrington Wimberly** has been designated by the Federal Power Commission as its official representative on the Interstate Oil Compact Commission. This is the first federal agency to designate an official representative on the Compact Commission following amendment of the commission's by-laws authorizing such appointment by any governmental agency charged with responsibility concerning oil and gas.

● **Frank M. Dawson** has been elected vice president in charge of operations and **Allen K. Brehm** treasurer of Carthage Hydrocol, Inc., it was announced by **Guy George Gabrielson,** president. The company will synthesize gasoline and other petroleum and chemical by-products from natural gas in a $15,000,000 plant to be erected near Brownsville, Texas. Dawson, a native of Houston, Texas, has been with The Texas Company for 18 years, most recently as superintendent of its Lawrenceville, Illinois, refinery. Brehm was formerly first vice president and a director of the Continental Bank and Trust Company of New York.

F. M. Dawson

A. K. Brehm

● **Wendell Richards,** district sales representative in Pittsburgh, Philadelphia, and Baltimore, has been promoted to the post of market research manager by R. G. LeTourneau, Inc., of Peoria, Illinois. **Cloyd Richards,** assistant service manager, has been named general service manager to succeed **C. F. Zimmerman,** who recently transferred to the sales field. **O. A. "Jack" Williams** has been appointed eastern sales manager to succeed **Harry Conn,** resigned. Replacing Williams is **C. F. Zimmerman,** former general service manager. Also announced was the appointment of **Harold R. McQuarrie,** eastern credit manager, to the newly-created post of assistant to the domestic sales manager.

● **E. W. Sanders,** manager of printers' supplies and industrial rolls, will head up the new tank lining and rubber-covered roll section into which the printers' supply department has been integrated, according to an announcement by the Goodyear Tire and Rubber Company. Three departments in the Mechanical Goods Division are being merged, according to **W. C. Winings,** manager. **R. W. Eckstein,** now assistant manager of tank lining, becomes manager, **Ernest Peterson,** assistant to Sanders, assumes new duties as manager of the industrial roll department.

● **Walter E. Caine** has been appointed secretary of the accounting section of the American Gas Association, it is announced by **H. Carl Wolf,** managing director, effective October 15. He succeeds **O. W. Brewer,** past-secretary of the section, who will devote his time entirely to the increasing duties of auditor and supervision of the association's accounting staff. Caine will continue to head the Bureau of Statistics. His title will be director of bureau of statistics, and, secretary, accounting section.

● **George S. Walden,** chairman of the board of Standard Vacuum Oil Company since 1934, has retired, and **Philo W. Parker** has been elected to succeed him. **Lloyd W. Elliott** succeeds Parker as president. The company also announced the election of **C. E. Meyer** and **C. K. Gamble** as vice presidents.

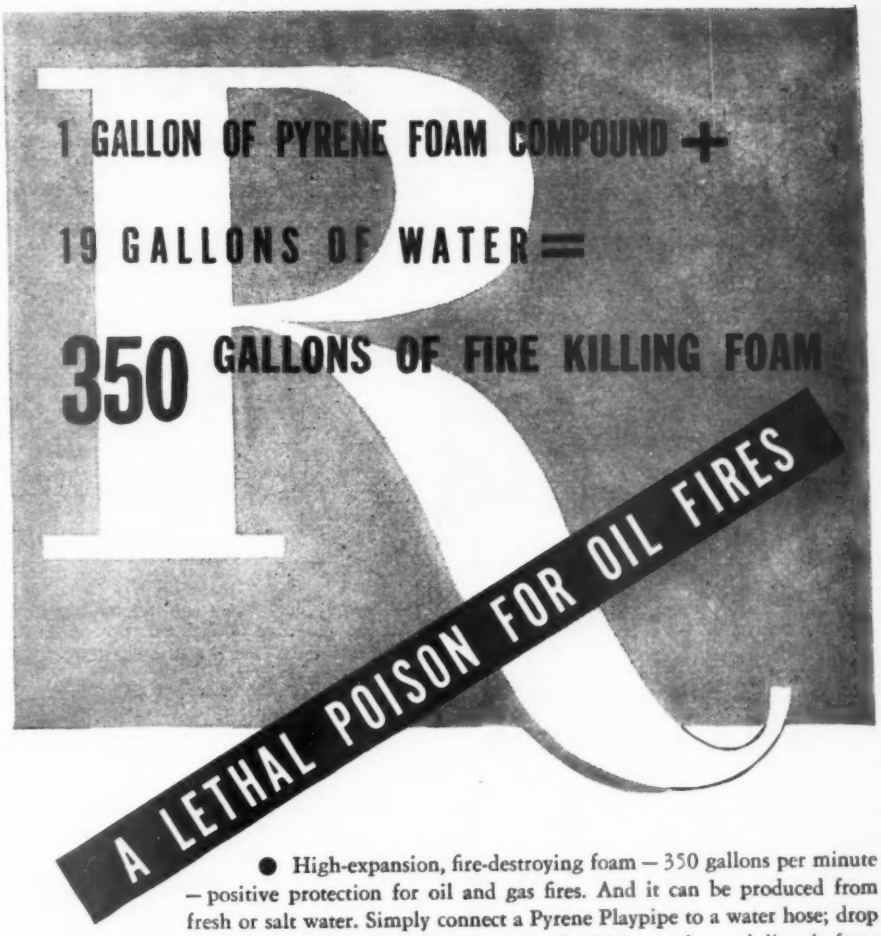
● **Robert D. Evans** has joined the sales development division of Caterpillar Tractor Company, Peoria, Illinois, as civil engineer consultant on earth-moving equipment and its application, according to **H. H. Howard,** general sales manager of the company. Evans joins "Caterpillar" from R. G. LeTourneau, Inc., where he functioned as chief field engineer.

● **John A. Field** has recently returned to the New York offices of Carbide and Carbon Chemicals Corporation as a technical representative for the Fine Chemicals Division. Associated with the corporation since 1936, Field has been on leave at the Reconstruction Finance Corporation's Office of Rubber Reserve in Washington, D. C., for the last two years, and was manager of the Production Control Section of that office prior to his return to industry. Field will specialize in the development of markets for new chemicals emerging from the research laboratories and entering the industrial field.

● **William H. Montgomery** has been appointed manager of the industrial relations department of the Socony-Vacuum Oil Company, Inc., it is announced by **C. F. Beatty,** director of the company. Montgomery has been refinery manager of the company's Lubrite Division, East St. Louis, Illinois, for the last three years. He succeeds **W. H. Zabriskie,** who has been appointed secretary of Socony-Vacuum's manufacturing committee.

● **George W. Bean,** who for 15 years has been the American Gas Association's fuel consultant, has resigned to again engage in individual representation work in Washington. He will continue to maintain offices in the Albee Building in Washington and will be available for specific retention by any utility. The Washington office of the American Gas Association was discontinued on October 1. Inquiries and requests for assistance on fuel problems involving government agencies should be addressed to New York headquarters.

● **Milton Lewis,** vice president, has resigned from The Fluor Corporation, Ltd., Los Angeles, California. This resignation became effective October 1, 1946.



● High-expansion, fire-destroying foam — 350 gallons per minute — positive protection for oil and gas fires. And it can be produced from fresh or salt water. Simply connect a Pyrene Playpipe to a water hose; drop the pick-up tube in the Foam Compound, which may be used directly from its shipping container, and direct the stream of foam at the fire. One man can do it in seconds, with equipment he can carry in his hands. Foam is made at the nozzle; there are no moving parts, and normal water pressure operates it.

Findlay, Ohio, tank test. A 93-foot tank of flaming oil was extinguished in 4 minutes with the same foam as produced by the Pyrene Foam Playpipe.

● If there is a combination of burning gas, oil or solvents and burning solids such as timbers or platforms, Pyrene Foam blankets the flaming liquid, and then, by merely removing the pick-up tube from the Foam Compound, a solid stream of water is immediately available to quench the embers or wet down adjacent structures.

● Pyrene Foam Makers with capacities ranging from 350 to 3000 gallons per minute can protect any size risk — from a small loading platform to big refineries and tank farms. Two types of foam can be used; *high expansion* for quick production of large quantities of foam, easily removable from the surface of the liquid, and *low expansion* for protection of recurrent fires where a long-lasting layer of foam is required. Let a Pyrene engineer help you plan your fire protection. Write for AIR FOAM, a booklet on Pyrene Foam.

Pyrene

Makers of Pyrene Tire Chains

Pyrene Manufacturing Company
NEWARK 8 NEW JERSEY
Affiliated with the C-O-Two Fire Equipment Co.

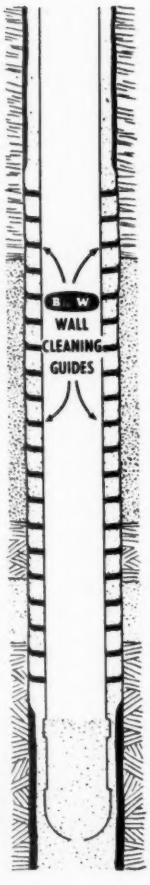
A Simple Formula
for a
GOOD CEMENT JOB
Use ENOUGH

Wall Cleaning Guides
and move the casing while cementing

B & W Wall Cleaning Guides do 3 things to promote successful completion . . . 1, scratch off mud cake from the wall of the hole; 2, center the casing; and 3, prevent channeling. By mounting the necessary number of these guides on the casing through the critical sections, with overlaps above and below, the casing is definitely and continuously centered by the torque action of the spring-steel wires. Raising and lowering the casing while circulating and cementing cleans away mud cake and gelled mud, and distributes the cement to make a water-tight sheath in perfect bond with the formation.

★

Get the full story . . . send for the NEW Bulletin No. 104 . . . "Successful Cementing," just published.



BRUCE BARKIS — B and W INCORPORATED — KENNETH WRIGHT
Well Completion Specialists
WEST COAST: 3545 Cedar Avenue
Long Beach, Calif. • Phone: L. B. 4-8366
GULF COAST: 305 M & M Building
Houston, Texas • Phone: Preston 9783

LAUGH WITH BARNEY

"Daughter, I hope that's a nice book you're reading."

"It is mother, except it's so sad at the end. The girl dies and he has to go back to his wife."

* * *

Wife: You were right, Henry, and I was wrong.

Husband: Forgive me, dear.

* * *

A concert was being held in a village schoolroom, and it was Sandy's turn to give his bagpipe solo. When he had finished and the applause had died down, a voice from the back shouted: "Give us Annie Laurie, Sandy!"

"What!" asked Sandy, surprised and flattered, "again?"

* * *

When you look at the financial condition of most nations today, you are inclined to think the old idea that the world is flat had some merit.

* * *

Wife: But why don't you want me to wear these tights in the amateur benefit show, dear?

Husband (grimly): Do you want everybody to say that I married you for your money?"

* * *

"What's a pedestrian, Daddy?"

"It's a man with a wife, a daughter, two sons, and one car."

* * *

A Protestant clergyman was walking down the street dressed in ministerial black when he met two Catholic boys. One of the boys, drawing conclusions from the garb, raised his hat and said, "Good morning, Father."

The other boy nudged him and whispered, "Quiet, stupid, he ain't no father, he's got a wife and three kids."

* * *

A mother noticed her high school son, who was getting ready to go to a dance, got dressed in record time.

"Boy, did you take a bath?" she asked him accusingly.

"No," came the reply.

"Now listen, son," she remonstrated, "you wouldn't go to a dance without taking a bath, would you?"

"Sure I would mom," came the reply. "It's not formal."

* * *

He: We sure had a good time last night for only fifteen cents.

She: Yes, and I wonder how my little brother spent it.

* * *

As the caller tipped his hat to the woman standing on the porch, she said: "If you are looking for my husband, he's gone fishing. Just walk down to the bridge and look around until you find a pole with a worm on each end."

* * *

Employer: For this job we want a responsible man.

Applicant: Then, that's me. Everywhere I've worked, when something went wrong they told me I was responsible.

* * *

Indian gals have a lot of fun with their beaux and errors.

"Hello, Jones. I understand you people employ a trouble shooter. Could I borrow him? I've got a little trouble I'd like to have shot."

* * *

"Yes," said the specialist, as he stood at the bedside of the sick purchasing agent, "I can cure you."

"What will it cost?" asked the sick man faintly.

"Five hundred dollars."

"You'll have to shade your price a little," replied the purchasing agent. "I had a better bid from the undertaker."

* * *

Then there was the sailor who treated all his girls to wine. He wanted a little port in every sweetheart.

* * *

Cop: No parking. You can't loaf here.

Voice from car: Who's loafing.

* * *

What the average woman wants is a strong, inflexible man who can be wrapped around her finger.

* * *

Roughneck: My wife says if I don't give up golf, she'll leave me.

Toolpusher: Hard luck, I'd say.

Roughneck: Yes, I'll miss her.

* * *

"There goes the fire engine. So long."

"Are you a volunteer fireman?"

"No, but my gal friend's husband is."

* * *

"What did you shay when you lost at shtrip, poker?"

"I shed plenty."

* * *

Teacher: Name the Great Lakes.

Pupil: Michigan, Superior, Huron, Erie, Ontario and Veronica.

* * *

Wife (to absent-minded professor): Your hat is on the wrong way, dear.

Professor: How do you know which way I'm going?

* * *

The young woman in the automobile ahead had her arm out, waving it aimlessly. The driver following could not interpret the signal and the two cars wound up in a collision.

"Lady," said the man, "I couldn't tell what you were signaling."

"I wasn't signaling," she replied. "I was drying my fingernail polish."

* * *

Mister (exuberantly): Man is never older than he feels. Now this morning I feel as fresh as a two-year-old.

Missus (sweetly): Horse or egg?

* * *

She: There's one thing I want to tell you before you go any further.

He: What's that?

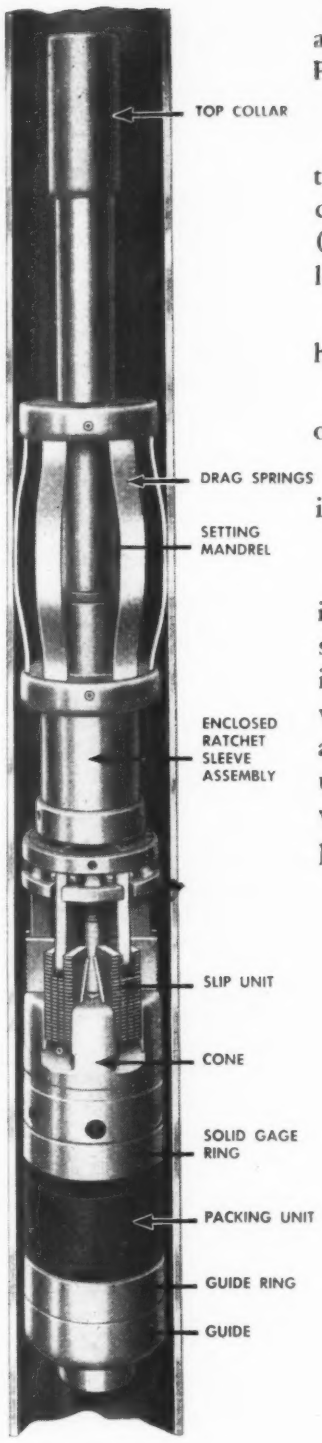
She: Don't go any further.

* * *

A lawyer was always lecturing his office boy, whether he needed it or not. One day he heard this conversation between the boy and one employed next door:

"How much does he pay you?" asked the latter.

"I get five thousand dollars a year," replied the lawyer's boy; "$10 a week in cash and the rest in legal advice."



Complete details on the Baker Model "RT" Retrievable Cementer (Product No. 411-RT) are available from any Baker representative.

THE BAKER MODEL "RT" RETRIEVABLE CEMENTER is a safe, positive "Hold Down Type" Packer primarily used:

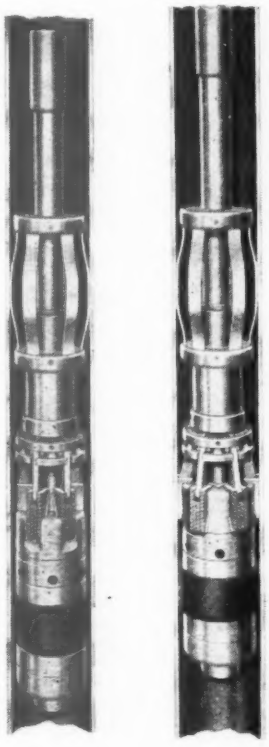
(a) for placing cement slurry, plastic, acid, or any other fluid, behind the casing or liner through perforations (or other openings) or in open hole below the shoe, at any necessary pressure;

(b) for testing casing or locating holes in pipe;

(c) for pressure-testing effectiveness of a previously performed cement job;

(d) to set in lime formations for acidizing and/or squeeze cementing.

The tool is operated mechanically and is not dependent upon fluid pressure to set or release. It functions successfully in high-pressure wells, where it will withstand, with a good margin of safety, any pressure that can be imposed safely upon the well casing. It can be used with equal efficiency and safety in low-pressure or low fluid level wells.



In running-in position

In expanded position

MANY ADVANTAGES

1. May be set and released at any place in the casing — as many times as desired — without removal from the well.

2. Can be run-in at a fast rate of speed — an advantage not possible when a cementer is equipped with swab cups, or is set by hydraulic action.

3. Tubing or drill pipe will not flow over while tool is being lowered in the hole with reasonable speed.

4. Circulation is possible completely around the tool which permits reverse circulation or circulating the long way.

5. The tool can be run-in immediately after a drill stem test; the mud conditioned; and a squeeze job performed, all in one run.

6. Fluid can be by-passed ahead of the cement slurry, plastic or acid by means of the Circulation Joint positioned immediately above the Cementer.

7. Testing the casing or protecting the casing after a squeeze job is possible by applying a reasonable pressure to the annulus after the Cementer is set.

8. The Baker Model "RT" Retrievable Cementer will withstand any pressure that is safe for the well equipment.

9. If the packing assembly should stick, or be cemented in the hole, it usually is possible to remove the *entire* Cementer; or, in extreme cases, all parts except drillable materials can be removed.

10. A drillable tail pipe, of any reasonable length, may be run below the Cementer, if well conditions demand it.

BAKER OIL TOOLS

BAKER OIL TOOLS, INC., LOS ANGELES • HOUSTON • NEW YORK

YOU

Are Invited to Try

SAND-BANUM

"The Entirely Different Boiler and Engine Treatment"

On a better than money back guarantee. Read this

UNCONDITIONAL GUARANTEE

Try it entirely at our risk for 30, 60 or 90 days. It must perform to your entire satisfaction or you owe us nothing. No money in advance; not even shipping charges.

Sand-Banum automatically and safely removes scale and corrosion while your equipment operates, regardless of water or operating conditions. Eliminates need for water analyses and special equipment.

Requires no expert handling—comes ready to use as is—All Active Ingredients—the carrying agent is missing.

For More Power
With Less Fuel
WRITE TODAY
For Test Sample

Safe-Certain-Economical

AMERICAN SAND-BANUM COMPANY, Inc.
9 Rockefeller Plaza, New York 20, N. Y.

Stocks carried by
WESTERN SAND-BANUM COMPANY
Houston, Texas
and at other convenient points including leading supply houses

Export Representatives
PETROLEUM MACHINERY CORP.
30 Rockefeller Plaza New York 20, N. Y.

Addresses A.I.M.E.

Before a meeting of the Chicago Section of the American Institute of Mining and Metallurgical Engineers on October 2, Dr. Gustav Egloff of Universal Oil Products Company discussed, "China's Mineral and Petroleum Potentialities and My Experiences There."

Dr. Egloff and W. B. Shanley, also of Universal, made a trip to China several months ago to investigate and report on the postwar possibilities of the oil industry under the auspices of the National Resources Commission of China.

Chicago manager

Stephen T. Goode has been appointed general manager of the Chicago office of N. I. Malmstrom and Company, New York, processors of wool fat and Lanolin. He joined the Chicago sales staff in 1945 following an absence of three years in the Army Air Force.

Steven T. Goode

Goode began his career with the company as a control chemist after which he joined the sales department, first in the New York area and later in Chicago.

Before being placed on inactive duty on June 21, 1945, he had flown 50 missions over Europe as pilot and bombardier, and was decorated ten times. He attained the rank of first lieutenant while in service.

A graduate of St. Johns University, Goode is a member of the Chicago Drug and Chemical Association as well as the Chicago Perfumery, Soap and Extract Association.

Collings to board

Election of L. Vincent Collings to the board of directors is announced by the Standard-Vacuum Oil Company.

Collings was born in Eton, New York, February 8, 1885, and graduated from Colgate University with a bachelor of arts degree in 1916. He was employed by Standard Oil Company of New York in July, 1916, and later that year was assigned to North China.

In 1923 he returned to the United States and entered the Harvard law school. He was graduated in 1926 with an LLB degree and was in private practice until 1934, when he was named assistant general council for Standard-Vacuum. He was named general council May 10, 1944.

W. E. Smith dies

William Edward Smith, 73, former president of the Standard Oil Company of Kentucky and veteran of 55 years in the oil industry, died October 2 in Louisville, Kentucky. He is survived by his widow, Eunice Weaver Smith of Louisville, and one brother, Walter A. Smith of Utica, New York.

Born in Buffalo, March 12, 1873, Smith attended local schools and the State Normal College at Fredonia. In 1890, he entered the oil industry in association with his father, Harry Smith, one of the pioneer developers of the Franklin, Pennsylvania, oil fields. Later he was associated with the Standard Oil Company of New Jersey and the Standard Oil Company of New York. In April, 1921, he resigned from Socony to become vice president of the Standard Oil Company of Kentucky and in 1927 was elected president and director. He retained this position until ill health forced his resignation last year.

For QUICK, ACCURATE TESTS
Use CURTIN CENTRIFUGES

No. 3420 15 c.c. machine . . . . Cranks and heads interchangeable with 100 c.c. machines.

Simple in design . . . Ruggedly built . . . Require no special care . . . Great Ratio and throw of crank produce required speed with no strain. Curtin Centrifuges meet all *A.S.T.M. Standard Method D-96-40* and *A.P.I. Code No. 25* requirements. Fully descriptive literature upon request.

W·H·CURTIN & CO.
DEP'T. "C"
HOUSTON, TEXAS . . . NEW ORLEANS, LA.

Perhaps this can
HELP SPEED
your
PRODUCT
IMPROVEMENT
program

See Page 34

Axelson appointments

Announcements of changes in personnel and additions to the Mid-Continent field staff are made by Axelson Manufacturing Company. These changes, effected since the war, restore a number of men to former positions after their return from the service.

Field personnel and changes and additions to Axelson's Pump and Rod Division in the Mid-Continent area are as follows:

Clarence W. Duplissey joined the U. S. Air Force and served for three years, attaining the rank of captain. With headquarters at Kilgore, Texas, Duplissey covers Overton and Kilgore store points and surrounding fields served by these stores.

J. W. (Bill) Rockwell resigned to enter the U. S. Army in August, 1942, and was terminated in January of this year with rank of captain. Coincident with date of his discharge Bill was reinstated with Axelson as representative in the Western Kansas territory with headquarters at Great Bend, Kansas.

Trumen R. Reader, who joined Axelson in 1938, and worked until June, 1942, when he "joined up," represented the company at Seminole, Oklahoma, and Hutchinson, Kansas, and is now back on the job representing Axelson in Mississippi and South Louisiana territory with headquarters at Jackson.

Chet Maguire now covers Axelson's West Illinois territory with headquarters at Olney, Illinois. He was first employed by Axelson in September, 1935, as representative at Seminole. He joined the Army in September, 1942, for a 3-year period.

D. L. McDonald, first employed by Axelson March 1, 1946, has been assigned the Alice-Freer, Texas, territory with headquarters at Freer, Texas.

Earl L. Chandler has been transferred from eastern Mid-Continent division to the Dallas, Texas, district. Chandler has been connected with the Axelson Manufacturing Company since 1926.

William A. (Bill) Russell has been appointed to the district vacated by Earl Chandler. Russell first joined Axelson in December, 1945, covering the states of Pennsylvania, New York, Michigan, Ohio, and West Virginia.

Jack Brander, now making his headquarters at Wichita Falls, Texas, covering the Electra, Muenster, and Wichita Falls district, first was employed by Axelson in November, 1937, and represented the company in Illinois until March, 1942, when he was inducted into the army. He was discharged with the rank of captain to resume employment with Axelson early last April.

Axelson Mid-Continent salesmen appointments: 1. C. W. Duplissey; 2. W. A. Russell; 3. J. W. Rockwell; 4. T. R. Reader 5. J. D. Brander; 6. Earl Chandler; 7. C. G. Maguire; 8. D. L. McDonald.

Made sales manager

George R. Vila, formerly assistant development manager, Naugatuck Chemical Division, United States Rubber Company, has been appointed sales manager of latex, Lotol, rubber dispersions and plastic products. The announcement was made by R. E. Casey, general sales manager for the

McVEAN & ROBERTS CONSTRUCTION

M&R

PIPE LINE

The Sign of Reliability

ODESSA, TEXAS

•

GENERAL PIPE LINE CONSTRUCTION

Odessa, Texas
P. O. Box 2607
Phone 1591

FT. Worth
501 Riverside Dr.
Tel. 3-4100

Looking Around

By THE OBSERVER

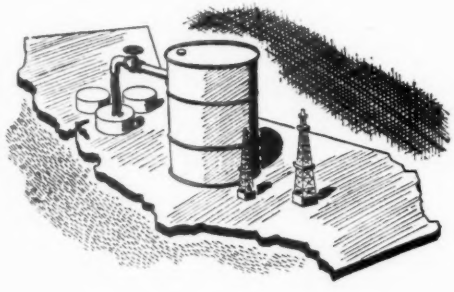
NO GOLDEN SPIKE, BUT A MIGHTY BIG BLACK SPLASH

The ceremony of opening a new crude oil pipe line for business isn't spectacular. No floral horseshoes. No golden spike. Somebody hollers, "Let 'er go!" and a man in overalls twists a gate valve. And there, with a boost from some husky pumps, goes the black, writhing oil on its way.

That's what happened recently at Kettleman City and Coalinga. Two and a half days later, the first of the oil arrived at Los Medanos on Suisun Bay, 176 miles away.

What's important, if not spectacular, is that from now on the light crudes of southern San Joaquin, Kettleman and Coalinga will flow to the refineries in a stream that can't be interrupted by tanker shortages or storms at sea. The important pipe line from Bakersfield and Kettleman over the Coast Range to Estero Bay will still handle heavy crudes—some 75,000 barrels a day. And the new line will handle 110,000 barrels a day.

We built an 8-inch pipe line, Bakersfield to Richmond, early in the century and used



it from 1904 to 1934. With the discovery of the Kettleman field we built the pipe line, a 10-incher, that crosses the Coast Range to Estero. Sea warfare and the tanker shortage in 1942 caused the oil companies to make combined use of an existing natural gas pipe line, leasing and converting it for oil.

We decided, come peace, to build this new 18-inch line of our own. We were at it from January to July. It's a $4,000,000 project, now completed, and we're proud of it. It's the biggest oil line we've built to date on the Pacific Coast. It will help us to serve the West better than ever.

STANDARD OF CALIFORNIA

Naugatuck Chemical Division of the rubber company.

Vila will make his headquarters at the chemical division's plant in Naugatuck, Connecticut. He will also maintain an office at the company's general office, 1230 Avenue of the Americas, New York.

Vila brings to his new position ten years' experience in the production, sales, and research phases of synthetic rubber, chemical, and plastics manufacture. He jointed the Naugatuck Chemical Division of the rubber company in 1936 as a technical sales representative specializing in rubber chemicals.

In late 1945, he went to Germany to investigate German research and production methods in the synthetic rubber field as a member of a research group sponsored by the Office of Rubber Reserve and composed of representatives from the four largest companies. He became assistant development manager for the company's chemical and synthetic rubber divisions in January of this year.

Executive vice president

C. M. Taylor has been elected executive vice president of The Lincoln Electric Company, Cleveland, Ohio, by the board of directors, it is announced by J. F. Lincoln, president of the company.

C. M. Taylor

Taylor has been with The Lincoln Electric Company since 1916, having been granted a leave of absence for service in World War I. He enlisted in the Air Corps in 1917 and returned at the end of the war, when he became a foreman. Later he was placed in charge of the company's time study and methods department, advanced to assistant superintendent and then superintendent. In 1928, he was appointed vice president in charge of sales and has served on the board of directors since 1927.

The newly elected executive vice president is a native Clevelander, having been born on a farm near Taylor Road in East Cleveland, Ohio. The Taylor residence is now on Brookwood Drive, South Euclid.

Taylor is a member of the American Welding Society, Cleveland Chamber of Commerce, Mayfield Country Club, the Union Club, and Alpha Delta Phi fraternity. He was educated at Prospect elementary school in East Cleveland, Shaw High School, and Western Reserve University.

Chemical division

J. Paul Sievers, president of Atlas Production Inc., announces the establishment of a new chemical division for the marketing of Hi-Perm, oil well cleaning chemical.

All field service engineering will be under the supervision of Norman C. Wells, who has had experience in various phases of the oil industry for 21 years. Wells is a graduate of the University of California at Berkeley of the class of 1925, and a member of Tau Beta Pi, honorary engineering society. He is an active member of the A.P.I. and A.I.M.E., and a charter member of C.N.G.A.

Hi-Perm will be the principal line handled by the chemical division. Complete well servicing will be handled out of the Santa Fe Springs office. Certain other commercial chemicals will comprise the materials handled by this new division.

Service over the years with FORGED STEEL UNIONS

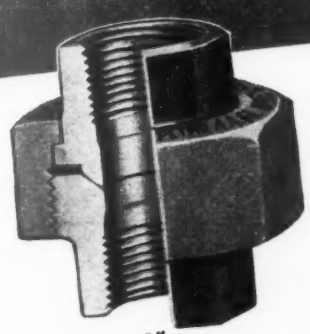
Unions are hot forged from solid round bars of high quality Open Hearth Forging Steel.

Handle-Bar

Hi-Speed Handle-Bar Unions with integral steel to steel seats, or completely fused bronze to bronze seats, black or Udylite (cadmium plated) — sizes from ⅜" to 4" inclusive in 4000 test, sizes 2" to 4" inclusive in 6000 test.

4000 Test Unions furnished with Briggs Standard steam threads in pipe ends, whereas the 6000 Test Union has long pipe ends with API line pipe threads. Nut threads are modified Acme to facilitate easy and speedy assembly and disassembly. Seat design is a 45 degree cone, machined and cold rolled, to a ball seat on male end. Handle-Bar Unions are recommended for all services where they are made up and taken down frequently.

Petro



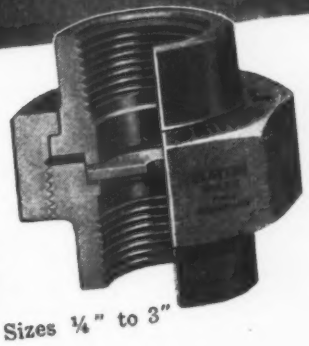
Sizes ⅛" to 3"

PETRO unions have integral steel to steel seats. Made to A. A. R. design. 600 lbs. S. W. P.-2000 lbs. C. W. P. Extra heavy ends and nut with nut threads that are permanently lubricated. The seats are machined and cold rolled.

Pressures from a vacuum to 3000 lbs.: Temperatures from 100° below zero F. to 1000° above zero F.: On Steam, Gas, Air, Oil, Gasoline, Ammonia, Chemicals, and any service in which Steel or Wrought Iron Pipe is used.

Orifice

Ideal for flow control of Steam, Oil, Ammonia, Water, Gas or Air. Also for metering and measuring. 600 lbs. S. W. P. or 2000 lbs. C. W. P. The ORIFICE plate is furnished in cold rolled 18-8 stainless steel. ORIFICE plate and gaskets are set in a groove of solid steel to safeguard against blowing of gaskets and resultant trouble. The ORIFICE union has extra heavy ends and nut with the nut threads permanently lubricated.



Sizes ¼" to 3"

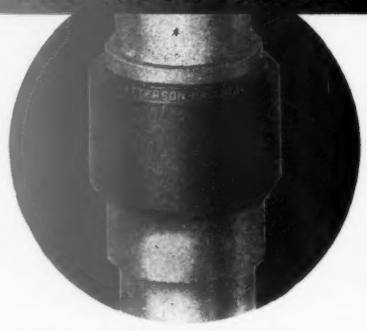
ORDER BY TRADE NAME FROM YOUR LOCAL SUPPLY STORE

ORIGINATORS AND PIONEERS OF FORGED STEEL UNIONS SINCE 1912

CLAYTON MARK & COMPANY

1900 DEMPSTER STREET • EVANSTON, ILLINOIS

"Best Bet Yet"
SAVE YOUR TUBING!



Tubing collars worn by contact with casing steal the profit out of pumping. Patterson - Ballagh Plastic Tubing Protectors prevent both collar and casing wear. Oil-proof, wear-resistant, insulating. They are cemented to the collar under pressure and will not come off. Made in all sizes. End your tubing troubles. CALL in your Patterson-Ballagh man.

Specify "Best Bet Yet"
PATTERSON-BALLAGH
A Division of Reed Roller Bit Co.
PLASTIC
TUBING PROTECTORS

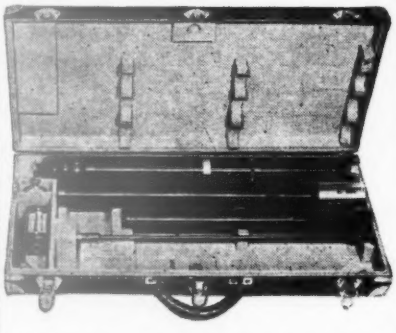
1900 E. 65th Street
LOS ANGELES 1

210 Post Street
SAN FRANCISCO 8

6247 Navigation Blvd.
HOUSTON 11

92 Liberty St.
NEW YORK 6

Eastman
presents...
POST WAR MODEL
Multiple Shot OIL WELL
SURVEY INSTRUMENT



Makes a continuous record in one run of the direction of the hole and its deviation from the vertical. The complete survey is plotted in our offices and a finished copy supplied to the customer. For accurate, dependable surveys, call the *Pioneers* of oil well survey service.

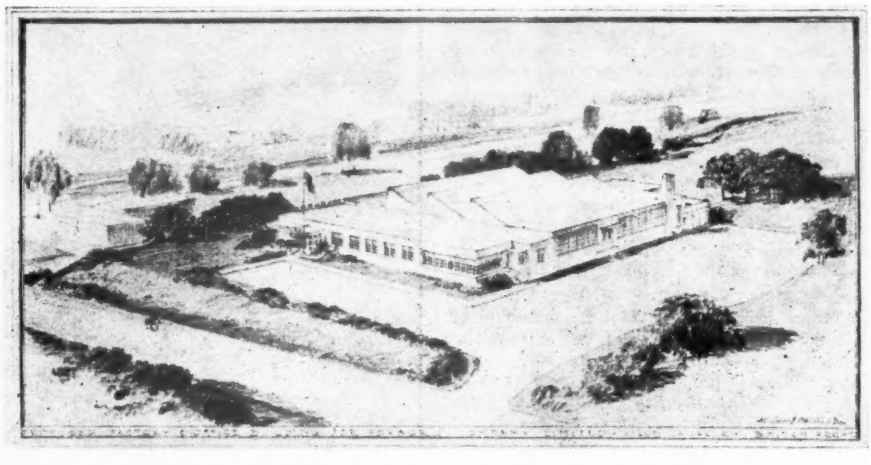
Eastman
OIL WELL SURVEY COMPANY
22 offices for your convenience
DENVER • LONG BEACH • DALLAS • HOUSTON

Guests at opening U.O.P. physics laboratory

Left to right: Arthur Van Vlissingen, Business Week; K. C. Sclater, editor, The Petroleum Engineer; Edwin F. Nelson, vice president, U.O.P.; R. C. Wackher, U.O.P.; Philip Hampson, Chicago Tribune.

Technical writers of the petroleum press and the Chicago daily newspapers were guests of Universal Oil Products Company at the formal opening and inspection on August 1, of the physics laboratory building, recently completed as a part of the U.O.P. research and development laboratories, Riverside, Illinois, a Chicago suburb.

In the accompanying photograph, Dr. G. M. Webb explains the microdensitometer.



Foxboro erecting Canadian plant

Foundation work is under way for the new plant that The Foxboro Company Limited is erecting on a three and one-half acre site in the Ville LaSalle section of Montreal. The completed building will be turned over to the owners in the spring of 1947, ready for immediate occupancy.

The new plant, of brick and steel construction, will consolidate machining, metal finishing, and other basic operations, as well as the assembly and calibration of instruments, on one floor level. Adequate window area, as well as saw-tooth skylights facing north, will insure uniform light distribution. One department, specially air conditioned, will be devoted to the printing and storing of recorder charts. Ample provision is made for offices, shipping, receiving, and storage departments. There will be a large, attractive room equipped for meetings as well as for use as the employes' lunch room and lounge. The plant site is adjacent to that of Peacock Brothers Limited, sales and service agents for Foxboro instruments in Canada and Newfoundland.

The Foxboro Company Limited is affiliated with The Foxboro Company, Foxboro, Massachusetts. The Canadian company, established in March, 1933, now occupies extensive space in the Peacock plant buildings, but the steady growth of both the domestic and export business make it desirable to consolidate operations in larger quarters, it is announced.

John H. Bolton continues as manager of The Foxboro Company Limited.

Returns to Homco

The Houston Oil Field Material Company, Inc., Houston, Texas, announces A. J. Adams' return after approximately four years absence. While on leave Adams served in the armed forces as a first lieutenant. Since his return he has been appointed assistant personnel director in Houston.

Roy W. Bythewood and O. C. Johnson have been employed as warehousemen in the sales department at Beaumont, Texas, and Mamou, Louisiana, respectively, by the company.

Thomas H. Cox is employed as mud engineer in the mud and chemical department at Houston. Cox studied petroleum engineering at Tulsa University.

R. E. Lunday has returned to Homco after an absence of about two years. He is employed as a salesman in the Houston area.

B. D. Burts and C. M. Standridge have recently joined Homco as directional drilling engineers. They will work in the New Iberia, Louisiana, district.

W. G. Seis and L. J. Lawrence, formerly salesmen at Victoria, have been transferred to Houston and Corpus Christi, Texas, respectively.

Lawrence A. Babin has recently been promoted from warehouseman to salesman at New Iberia, Louisiana. Jack Stone, mud engineer, has been transferred from Eunice, New Mexico, to the Homco store at Odessa, Texas. Tom C. Flowers has been promoted from maintenance man at Victoria to fishing tool operator at Houston. W. O. Smith, formerly clerk in the Houston industrial sales department, has been promoted to salesman in that department. Reed Elliott has been transferred as warehouseman from Beaumont to Mamou, Louisiana. Jack O'Neal Massey has been promoted from warehouseman to field salesman at Raymondville, Texas.

Firm name changed

Wm. A. Johnson, West Coast contractor, has acquired the interest of his former associate, Vern D. Case, in Case Construction Company, it is announced. The firm will henceforth be known as the Johnson Western Company. Case is withdrawing to devote his entire time to other interests.

Management of Johnson Western Company will be in the hands of Elden Smith, president, and Harry Gast, vice president and general manager.

The key personnel and operating plant of the organization remain unchanged. Eldred Northup, who has served Case for 14 years, continues as operations manager. L. J. Sullivan, D. W. Shupp, and E. E. Jackson will, as heretofore, manage the Los Angeles, San Francisco, and San Diego divisions, respectively.

A.P.I. district meetings

Dates for 1947 Spring meetings of three district organizations of the Division of Production of the American Petroleum Institute have been set.

The Eastern District production meeting will be held at the William Penn Hotel, Pittsburgh, Pennsylvania, on April 16, 17, and 18, 1947, Chairman R. L. Anderson, Columbian Carbon Company, Charleston, West Virginia, announced.

The Mid-Continent District meeting will be held at the Herring Hotel, Amarillo, Texas, May 22 and 23, according to Chairman H. S. Kelly, Phillips Petroleum Company, Bartlesville, Oklahoma.

The Pacific Coast District will gather at the Biltmore Hotel, Los Angeles, May 15 and 16, Chairman M. W. Morris, Standard Oil Company of California, reported.

...for better valve service!

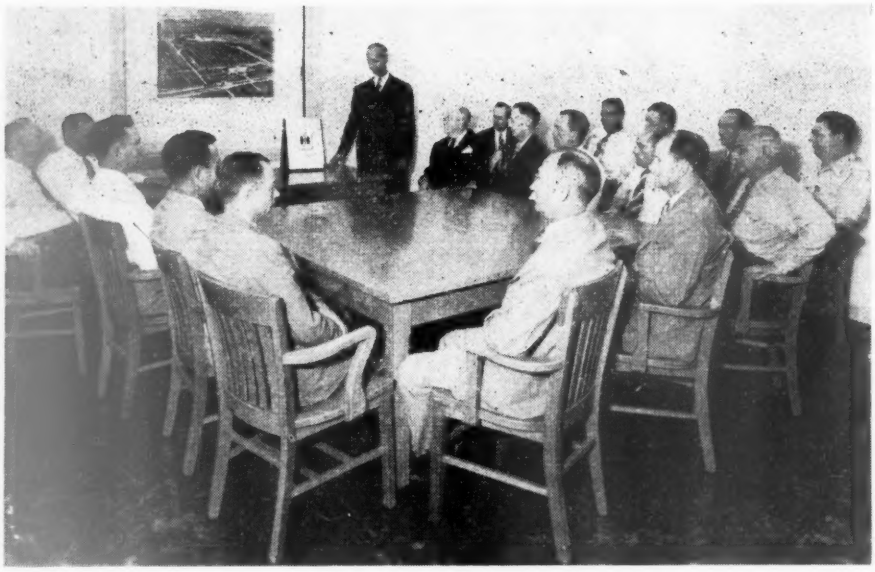
For production economy and efficiency, you must, of course, have good valves to begin with. That's why maintenance men prefer Lunkenheimer longer-life Valves . . . correctly engineered, quality built, dependable.

Yet in themselves even the best valves are not enough. A convenient source of supply and dependable service are equally important.

Lunkenheimer Distributors, located in principal industrial centers, render a *complete* valve service that saves time, trouble and money. Trained, qualified representatives are at your call to help with your valve problems.

For better, experienced valve service, call your nearest Lunkenheimer Distributor.

THE LUNKENHEIMER CO.
Cincinnati 14, Ohio, U. S. A.
NEW YORK 13, CHICAGO 6, BOSTON 10; PHILADELPHIA 7
EXPORT DEPT., 318-322 HUDSON ST., NEW YORK 13



Promotional information

An elaborate 66-page pyramid portfolio illustrating and describing the promotional program of the Industrial Power Division of International Harvester Company is now being shown to distributors throughout the country. This presentation brings to International Harvester distributors, for the first time, an overall picture of the company's advertising and sales promotion program.

In the picture, H. R. Carlson, International zone manager, is demonstrating the portfolio to the sales organization of the Browning-Ferris Machinery Company, International industrial distributor at Dallas and Houston, Texas.

Seated at the table, left to right: Royal A. Ferris, Jr., R. B. Wadsworth, B. D. Williams, T. C. Foley, J. F. Forester, M. C. Womack, H. F. George, M. J. Jones, G. L. Harris, J. A. Turpin, H. L. Burleson, W. A. Browning. Along the wall, seated, left to right: R. H. Siler, J. T. Jackson, G. L. Stroud, J. C. Haislip, Jr., and J. C. Quinn. Standing, H. R. Carlson, International Harvester Company.

New diesel power units and crawler tractors soon to come off the production lines at International Harvester's Melrose Park Works, near Chicago, will be announced in the advertising pages of 52 publications, according to the information supplied in the portfolio. The program is designed to reach every contractor, municipality, miner, logger, diesel power user, oil-field operator, and public utility in the country.

This information program will keep pace with the expanding manufacturing facilities of the Industrial Power Division.

Open new offices

Watts, Payne-Advertising, Inc., of Tulsa, Oklahoma, has recently opened new offices in Dallas, Texas, and Wichita, Kansas.

Burke Gilliam has been named manager of the Dallas office. Before entering military service, Gilliam was vice-president of the Watts, Payne-Advertising Agency.

Donald Schall, well-known Kansas public relations man, will head the Wichita office. Schall has been active in Wichita advertising for several years.

Established in 1930, Watts-Payne now has more than 50 accounts throughout Oklahoma, Kansas, and Texas and these two new offices will strengthen the service rendered manufacturers whose principal market is the southwest.

Name representative

Kieley and Mueller, Inc., announce the appointment of the Fluid Controls Company, 18 West Chelton Building, Philadelphia 44, Pennsylvania, as their accredited representative in the Philadelphia-Harrisburg area.

The Fluid Controls Company is an organization experienced in providing complete control engineering service for the process industries and will handle the complete line of Kontrol-motor diaphragm valves, pressure regulators, pump governors, float valves, etc.

Look for the STRONG *Arm-and-Hammer*

ARMSTRONG BROS.

Better PIPE TOOLS

ARMSTRONG BROS. Pipe Tools are built to stand up under the most rugged service—all have extra strength and many design improvements.

ARMSTRONG BROS. Chain Tongs, for example, have drop forged, heat treated jaws with milled teeth. Have forged-in lugs that increase bearing of jaws on bar and also serve as chain guides—prevent kinking. Bolt is large and hardened. Shackles drop forged alloy-steel. Chains are proof-tested to 2/3 catalog strength (3,600 to 40,000 lbs.). Handles are forged and heat treated. Standard, Reversible Jaw and "Ideal" V-jaw Types. Write for Catalog.

ARMSTRONG BROS. TOOL CO.

331 N. Francisco Ave. Chicago 12, U.S.A.

McCullough Ventura office moves to new building

Because its gun-perforating and fishing tool service in the Ventura area demanded greater shop facilities, the McCullough Tool Company has erected a new hollow tile and concrete buiding at 1213 Ventura Avenue. The greatly increased shop facilities in the new headquarters are expected to allow considerable expansion of service, company officials annnounce.

Al Pruitt remains as district manager in charge of the new office. With him are Pete Oaks, on fishing tool service, Hap Miller, heading gun-perforating service, Jess King, Harry Gilmour, and Vearl Sanders. The telephone number is Ventura 4425.

Welding division branch

A new branch of the G-E Electric Welding Division was recently opened in Houston, Texas, to give improved service to the welding industry in that area. Situated in a new building 60 ft. wide and 120 ft. long, the branch sells the complete line of G-E arc-welding products as well as other manufacturers' products of interest to users of arc welding. Facilities are available for demonstrating welding processes and techniques, and a completely equipped service and repair shop is maintained.

F. C. Neal, Jr., manager, received a degree in industrial engineering from Kansas University in 1936. He entered the General Electric Company's test course at Schenectady, and later became a member of the company's Electric Welding Division as an application engineer. He was later transferred to Dallas as southwestern district arc-welding specialist. In January of this year he went to Houston to organize the welding division there. He is a member of the American Welding Society.

C. L. Helms, office manager, entered G-E's business training course in 1928, and worked as an accountant in Schenectady until 1932, when he joined the company's Air Conditioning Department in Bloomfield, New Jersey, in a similar capacity. He was later returned to the general office in Schenectady, and was sent to Houston in January.

Texas Company changes

J. H. Puls has been appointed assistant manager of the Producing Department, Pacific Coast Division, of The Texas Company, and A. W. Sands replaces Puls as superintendent of drilling and production operations, it was announced by Torrey H. Webb, vice president.

Puls is a graduate of the California Institute of Technology in mechanical engineering and was first employed by the company in 1925 in refinery and pipe line engineering. In 1937 he was placed in charge of mechanical and production engineering at Long Beach and transferred to Los Angeles in 1940 when he became division engineer in charge of the civil, production, and development engineering staff for the Pacific Coast area. He succeeded W. H. Farrand as division superintendent of drilling and production in December, 1944.

Sands, a graduate of Stanford University with a degree in geology, began with the company as a member of drilling crew in August, 1926, and became resident geologist in the Ventura district in November, 1926; later serving in other capacities as assistant to division superintendent in the Los Angeles Basin area, superintendent of production operations in Ventura district, and as assistant superintendent drilling and production operations for the Pacific Coast division, his former position.

George Hays resigns

George A. Hays, Jr., has resigned as vice president of Oil Well Supply Company, Dallas, Texas, U. S. Steel subsidiary, a position he has held since 1939, according to an announcement by Fred F. Murray, president. Murray expressed regret at the resignation and stated further that he understood Hays will announce his plans soon.

Oil is an indispensable source of power today in an America that moves on wheels to a greater future.

More than 15 years ago the First in Dallas pioneered in helping to provide for the financial needs of the petroleum industry. Today, the First in Dallas is geared to serve the oil industry and welcomes the opportunity to be of service to oil men everywhere.

First National Bank in Dallas

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

1st NATIONAL

Feuille retires

Judge Frank Feuille, vice president and director of California Commercial Company, Inc., subsidiary of Standard Oil Company of California with headquarters in New York, has retired after 26 years' service, first with Standard and later with its subsidiaries, as an advisor on matters relating to Latin America.

Feuille, a member of the New York Bar, was born September 10, 1860, in Havana, Cuba, and went to New York at the age of five. In 1875, he moved to Texas, and in 1886 was graduated from the University of Texas Law School with honors. Later he became city attorney of Brownsville, Texas.

In June 1902, Feuille accepted a judicial office in Puerto Rico and two years later was appointed Puerto Rican attorney general by Theodore Roosevelt. In 1907 he went to Cuba to draft an outline of new laws for a democratic form of government. With only a few changes, his outline represents the laws of Cuba today.

He was sent to Panama in 1910 as counsel and chief attorney for the Panama Canal and Panama Railroad. In this post he aided Col. George W. Goethals, the builder of the Canal. One of his tasks was removing thousands of residents from the Canal Zone, arranging to pay them for their lands and provide them with free transportation to their native countries. During World War 1, Feuille was appointed acting Governor of the Panama Canal and vice president of the Panama Railroad.

Feuille left Panama in 1920 for New York and joined Standard that same year.

YOUR ASSURANCE of MAXIMUM PIPE PROTECTION

Our name on the Kraft Paper Wrapper is familiar to thousands of prominent corrosion engineers who say, that HILL, HUBBELL factory processed pipe gives MAXIMUM protection against the ever present destroyer — CORROSION.

Your under ground pipe investment is safe-guarded longer with HILL, HUBBELL pipe protection.

GENERAL PAINT CORPORATION
HILL, HUBBELL & CO. • Division • Cleveland, Ohio
• EXPORT OFFICE: SAN FRANCISCO, CALIFORNIA, U. S. A. •

New Young appointments

Two new appointments, one of a new service manager and the other a special representative, have been announced by the Young Radiator Company, Racine, Wisconsin, manufacturers of heat transfer equipment.

Peter J. Fink, new service manager, has filled various preparatory positions with

L. B. Smith

Peter J. Fink

Young for the last several years. Prior to his association with Young he has been active in cost work, direct sales, and trouble shooting thereby being ably qualified to fill his new position.

Lloyd B. Smith, special representative in the Pacific Northwest territory possesses excellent qualifications to serve Young Radiator Company's customers. A graduate of the University of Washington with more than 30 years' experience in commercial and industrial work, Smith will make his headquarters at Bellevue, Washington, P. O. Box 357.

Shell appoints Lockhart

C. L. Lockhart, former operations manager of Shell Oil Company's Cleveland, Ohio, division, has been appointed manager of Shell's Sewaren, New Jersey, plant, it is announced by P. E. Lakin, vice president, marketing. Lockhart succeeds H. V. LeBourveau who died recently.

Born in Shoals, Indiana, Lockhart was graduated from McKinley High School, St. Louis, Mo. After gaining experience in the automotive field, he began his career with Shell in 1929 as chief inspector of the St. Louis automotive department. Thereafter, he progessed through various positions of increasing responsibilities in the operating departments of the company's division offices. In 1940, he was appointed operations manager, marketing operations, in the Cleveland office, which position he held until his present appointment.

Lockhart is succeeded by J. S. Morse, who was operations manager in Shell's Detroit division prior to joining the Navy in 1942. Morse was released with the rank of lieutenant commander in February of this year. Since his return, Morse has been assistant to the plant automotive manager in New York in charge of a special package handling study.

To head S.A.E.

C. E. Frudden, consulting engineer of the Allis-Chalmers Manufacturing Company Tractor Division, became the sole nominee for the 1947 national presidency of the Society of Automotive Engineers, according to G. W. Curtis, general chairman of the society's eleventh annual tractor meeting recently concluded in Milwaukee, Wisconsin. The nomination is tantamount to election.

Frudden will be the first Wisconsin man and the first tractor man elected to the presidency of the 40-year old society. He will take office at the end of January and begin administering the affairs of the S.A.E.

Awarded "Oscar"

Bowser, Inc., Fort Wayne, Indiana, liquid control manufacturer, was awarded a bronze "Oscar of Industry," signifying first place among metal products industry reports to stockholders for 1945. Eugene Nahm, Bowser New York representative, received the trophy in a banquet ceremony at the Waldorf Astoria Hotel October 4.

The Bowser report was judged best in its field by a committee composed of Dr. Lewis Haney, professor of economics at New York University; C. Norman Stabler, financial editor of the *New York Herald-Tribune;* Glenn Griswold, editor of *Public Relations News;* Sylvia F. Porter, financial editor of the *New York Post;* and Lester Tichy, industrial designer and artist.

The "Oscar" was awarded by the magazine *Financial World*, in its sixth annual survey of stockholders' reports.

Sales conference

Thirty sales representatives of the Dollinger Corporation, from every section of the United States, including the West Coast and Texas, got a preview of new designs of Staynew Filters at a three-day sales conference September 20, 21, and 22. The conference was held at the company's Rochester plant and at Longue Vue, Thousand Islands.

Inspection of the plant and study of manufacturing processes were followed by examinations of new models of Staynew Filters for air, other gases, and liquids. These included special high pressure and high temperature pipe line models and large-capacity automatic filters for ventilating systems.

L. L. Dollinger, Jr., addressed the group on "Ventilation Filters" and K. E. Ellis of the sales department spoke on "Industrial and Liquid Filters."

Carl Beal dies

Carl Hugh Beal, 57, noted geologist and one of the discoverers of the famous Kettleman Hills oil property, died September 7 in the Hollywood Hospital after a long illness.

Beal, who was rated as one of the four greatest geologists in the world, was born July 16, 1889, in Morton County, Kansas. He was a graduate of Stanford University, where he later was a member of the geological faculty in 1914 and 1915 and was assistant professor of petroleum engineering in 1919 and 1920.

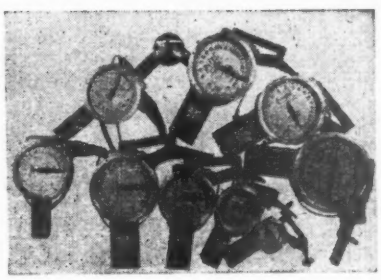
Later he was an oil and gas inspector for the U. S. Indian Service, petroleum technologist for the U. S. Bureau of Mines, and a valuation expert for the Bureau of Internal Revenue. After he left the Federal agencies he became a consulting geologist and for a time was associated with the Marland Oil Company. At the time of his death he was a member of the board of directors of Tide Water Associated Oil Company.

He is credited with discovery of Seal Beach and San Miguelito oil fields, wrote the first treatise on oil land valuation for the government, and shortly before his death had completed a lengthy work entitled "Geology of Baja California," soon to be published by the Geological Society of America.

Beal explored Baja California, some years ago and was enthusiastic over the possibilities of future oil production there.

He also was a member of the American Institute of Mining Engineers, the American Association of Petroleum Geologists, and was a charter member of the Geological and Mining Society of Stanford University.

LINE SCALES



10 of the 20 Models we manufacture. 40.000 pounds to 500,000 pounds. A special scale for any job.

With a Line Scale you know the pull on the line, and the weight on the bit in pounds. Accurate, sensitive, rugged and economical.

Line Scales are dependable, even in areas of rapid temperature changes. Repeated tests prove the accuracy of Line Scale readings under all working conditions.

See your supply man, now

LINE SCALE CO., INC.

Phone 2-1765, 907-11 SE. 29th Street, Box 4245
OKLAHOMA CITY, OKLAHOMA

"OF COURSE, Thompson IS PART OF MY STANDARD DRILLING EQUIPMENT"

From your smallest to your largest well, there is a Thompson Shale Separator and Sample Machine to meet your most critical mud cleaning requirements. Saves You Money . . . by removing destructive shale and abrasives from drilling mud, thus reducing wear and tear on costly drilling equipment. Sample Machine attachment provides accurate foot by foot samples of cuttings. We can deliver Now! Order through your supply dealer or direct from the factory.

- SELF-MOTIVATED
- RECONDITIONS MUD
- ACCURATE SAMPLES
- UNLIMITED CAPACITY

THOMPSON TOOL CO.
IOWA PARK, TEXAS

KEEPS DRILLING MUD CLEAN — PROVIDES *TRUE* SAMPLES OF CUTTINGS

DRAFTSMEN

DESIGNERS AND CHECKERS
with experience on
Structural Steel and Concrete
Process Piping
Pressure Vessels

The Boston office of E. B. Badger and Sons Co., internationally famous chemical engineering organization, offers qualified men well-paying positions. This is a fine opportunity for men who would enjoy working in congenial surroundings and with pleasant cooperative associates. A personal interview can be arranged in your city. This is not a temporary position. Write, giving full details of background and experience, salary wanted, etc., to

Mr. William M. Rose, Personnel Director
E. B. Badger and Sons Co.
75 Pitts Street, Boston, Mass.

HELP WANTED—Corrosion and Cathodic Protection Engineer. Graduate Engineer under 35 with some experience to supervise, direct and coordinate work of this character in connection with transmission of natural gas in Montana and the Dakotas. Address Box 52, c/o The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

NEW 16" BLOCKS

Triple and quadruple cast iron sheaves. Steel shell. Self lubricating. Bronze bushed. Loose side hook and becket. For 1" wire rope. Priced right.

Wire, Write, or Phone

Glazer Steel Corporaton

2100 Ailor Ave. Knoxville, Tenn.

Phone 3-0738

HELP WANTED—Measurement and Gas Metering Engineer. Graduate Engineer under 35 with experience to supervise and direct measurement and testing in connection with production and distribution of natural gas in Montana and the Dakotas. Address Box 53, c/o The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

WANTED FOR FOREIGN SERVICE

REFINERY SUPERINTENDENT

We want a man of wide experience in topping, cracking, treating and all other phases of modern oil refinery operations, enabling him to take full charge of a large, complete refinery. Technical ability required and with it, exceptional initiative, executive ability and resourcefulness.

CHIEF ENGINEER

Must have wide and varied experience which qualifies him to take full charge of construction maintenance and process engineering of a large, complete oil refinery. Exceptional initiative, executive ability and resourcefulness required.

MARINE TERMINAL MANAGER

Thoroughly experienced in all phases of marine movements of petroleum products and the design, construction, operation and maintenance of a marine terminal.

Address Box 51
c/o THE PETROLEUM ENGINEER
P. O. Box 1589 Dallas, Texas

Suggest MULTIPLE OWNERSHIP to your SMALL REFINERY associates

See Page 34

Gray buys works

One of the leading oil tool manufacuring companies changed ownership Sepember 21, 1946, when all the capital stock in the American Iron and Machine Works Company, of Oklahoma City, was sold by John F. Cailloux and Earl W. Miller to James A. Gray of Houston, Texas.

Early history of this company dates back to March, 1923, when Cailloux opened a small repair shop at Tonkawa, Oklahoma. A few months later, a patent owned by the company attracted Miller's attention, and in early 1924 he started selling the product

John F. Cailloux

Earl W. Miller

covered by this patent. Month after month, the new business continued to expand rapidly. In March, 1925, Miller purchased stock in the company and became active in its management.

It was not long before both Cailloux and Miller could foresee the need of moving their plant to a larger city, and they were able to move their headquarters from Tonkawa to Oklahoma City in June, 1926. The foresight of these men was quickly justified by the rapid expansion of their company. Each year saw the continued enlargement of both office and plant facilities, until today the once small repair shop in Tonkawa has mushroomed into a national organization, serving every oil field in the country as well as engaging in extensive export activities.

It was during the war years, when American Iron and Machine Works Company was working 24 hours a day to meet the heavy demands of both government orders and oil field needs at home, that the decision was reached to concentrate all efforts on the Oklahoma City plant. Consequently, in January, 1945, the firm's five branch field-shops were sold to employees who were then running them.

Sier-Bath changes name

Sier-Bath Gear and Pump Company, Inc., is the new name of the former Sier-Bath Gear Company, Inc., 9252 Hudson Boulevard, North Bergen, New Jersey. According to E. J. Bianchi, president, this change in corporate name was made so it would be truly representative of the company's expanded line of products. In addition to the precision gears, which Sier-Bath has manufactured since 1905, the firm also makes rotary pumps.

Named assistant

James D. Greensward has been named assistant to William C. Johnson, vice president of the general machinery division of the Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin.

Holder of an electrical engineering degree from Marquette University, Greensward has been associated with Allis-Chalmers since 1922. Since 1942 he was treasurer's assistant in charge of contract terminations.

Homco purchases firm

Houston Oil Field Material Company, Inc., Houston, Texas, has purchased the common stock of Briggs-Weaver Machinery Company of Dallas from Dallas Rupe and Son of Dallas and Dewar, Robertson, and Pancoast of San Antonio. These Texas investment banking firms had acquired Briggs-Weaver in 1944.

Briggs-Weaver Machinery Company, which celebrated its fiftieth anniversary in August, is one of the oldest distributors of industrial machinery and supplies in Texas. Its lines include oil-field equipment, machine tools, water works, and power plants. In its three-story plant at 309 North Market Street in Dallas it has a machine shop, offices, and wholesale and retail departments.

Meter contest winners

W. W. Hurlbut of Los Angeles, California, and Miss Hazel V. Dennis of Baltimore, Maryland, were the first prize winners in the 100 per cent metering contests sponsored by the Pittsburgh Equitable Meter Division of Rockwell Manufacturing Company, Pittsburgh, Pennsylvania.

These contests, designed to stimulate public thinking on the community advantages of 100 per cent water metering, were split into two groups. Contest No. 1 was the completion of a jingle about universal metering. Contest No. 2 was of the essay type with contestants required to write a paper on the community benefits from metering services.

Heads SKF district

Appointment of Harrison Wood as New York district manager for SKF Industries, Inc., ball and roller bearing manufacturers, is announced by R. R. Zisette, general sales manager for the company.

Wood, assistant district manager since 1941 and for many years a field engineer for the firm, succeeds John D. Williamson, who resigned because of ill health after serving as head of the district for 23 years.

The district embraces New York City, the southern tier of New York State, and northern New Jersey.

A native of Baltimore, Wood attended Cornell University and joined SKF in 1923 as sales engineer.

Receives medal for merit

Sidney S. Smith, manager of the products pipe line department of the Shell Oil Company, New York, was presented the Medal for Merit, the country's highest civilian award, recently in Tulsa, Oklahoma.

Sidney S. Smith

Smith received the award in recognition of his services in the development of the portable military pipe line, which played a major role in transporting huge quantities of gasoline to the mechanized forces of the Allies during the war.

Building contract awarded

Standard of California has announced award of a bid for construction of a process laboratory building at the Richmond plant of California Research Corporation, Standard subsidiary.

The contract was won by Swinerton and Walberg Company with a low bid of $732,360. Work will begin immediately.

The new structure will centralize research facilities now housed in a number of smaller buildings and provide space for additional research work not now possible.

The construction will be part of the $10,000,000 replacement, improvement, and new construction program announced for Richmond Refinery and California Research.

N.A.C.E. secretary

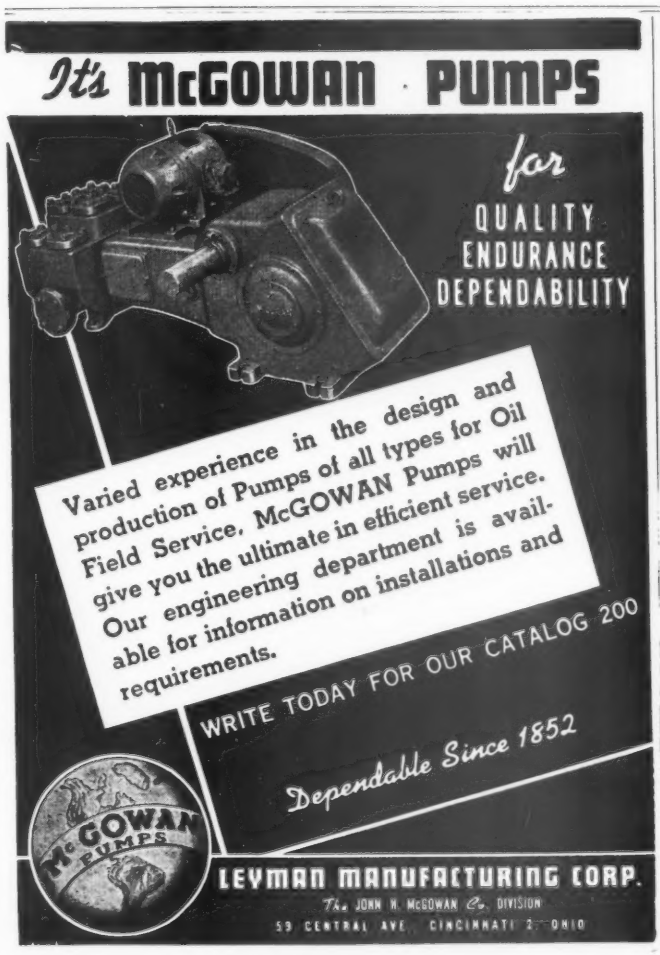
A. B. Campbell, formerly eastern representative of Hughes Brothers, has accepted the position of executive secretary of the National Association of Corrosion Engineers, with headquarters in Houston, Texas.

Campbell is a graduate in electrical engineering of the University of Illinois and also has the professional degree of electrical engineer from that school. From 1915 to 1920 he was on the faculty of the Engineering Extension Department of Iowa State College. From 1920 to 1923 he served as electrical engineer on the Iowa Board of Railroad Commissioners. He was an engineer on the headquarters staff of the N.E.L.A. and the E.E.I. from 1923 to 1943, at which time he joined Hughes Brothers.

Gardner-Denver promotes

Gardner-Denver Company announces the promotion of B. P. Spann, formerly advertising manager of the company, to personnel and industrial relations director. Spann, who has been with the Gardner-Denver Company since 1934, with the exception of 38 months in the Navy, where he attained the rank of lieutenant commander, will be in charge of all factory and office personnel for the Gardner-Denver Company's Quincy plant.

The new Gardner-Denver advertising manager is D. P. Tunnicliff. Tunnicliff graduated from the University of Illinois in 1943 with a B. S. degree in journalism (advertising). He was formerly employed by the Quincy Herald-Whig in an editorial capacity, after three years in the Navy.


It's McGOWAN · PUMPS
for
QUALITY
ENDURANCE
DEPENDABILITY
Varied experience in the design and production of Pumps of all types for Oil Field Service, McGOWAN Pumps will give you the ultimate in efficient service. Our engineering department is available for information on installations and requirements.
WRITE TODAY FOR OUR CATALOG 200
Dependable Since 1852
McGOWAN PUMPS
LEYMAN MANUFACTURING CORP.
The JOHN H. McGOWAN Co. DIVISION
59 CENTRAL AVE. CINCINNATI 2, OHIO

ROCKFORD
POWER
TAKE-OFFS
SELF CONTAINED UNIT
WIDE RANGE OF SIZES
CONSERVATIVE RATING
ROLLER BEARINGS
FINE ADJUSTMENT
ACCURATE BALANCE
S.A.E. DIMENSIONS
*Completely self-contained units, ROCKFORD POWER TAKE-OFFS are designed for use in connection with internal combustion engines and are adaptable to standard S.A.E. flywheel housings. Secured to the housing, the ROCKFORD POWER TAKE-OFF forms an integral unit, providing perfect alignment.
Send for This Handy Bulletin
Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.
BW
ROCKFORD CLUTCH DIVISION BORG-WARNER
1303 Eighteenth Avenue, Rockford, Illinois, U.S.A.

Plane makes initial flight

To maintain its progressive policies in sales as well as production, the John A. Roebling's Sons Company, Trenton, New Jersey, has purchased a five-passenger airplane for closer contact with its customers, distributors, and branch offices.

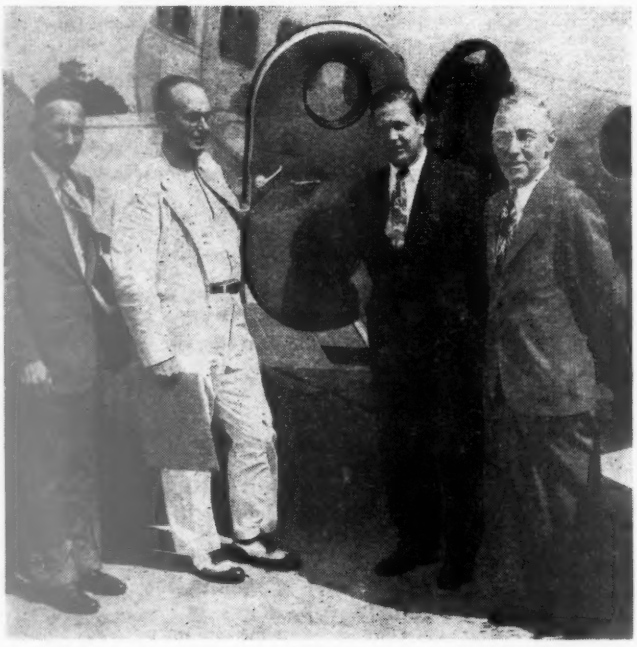
On its initial flight the plane covered 10,000 miles, carrying Charles R. Tyson, president of the company, along with Ernest C. Low, vice president in charge of sales, Charles M. Jones, vice president in charge of public and industrial relations, and Forest S. Burtch, manager of wire rope sales.

The plane has two 450-hp. motors, two-way radio, and other safety devices and equipment. An experienced pilot and co-pilot have been hired, full time, to operate the plane.

Before leaving Trenton, Tyson announced that the plane will be utilized most for the purpose of bringing Roebling personnel closer to its customers in the various trades it serves.

On its maiden flight the Roebling plane stopped at Toledo, Salt Lake City, Butte, San Francisco, Sacramento, Grass Valley, Fresno, Bakersfield, Los Angeles, Morenci, Globe and Miami (Arizona), Houston, New Orleans, and Atlanta.

Left to right: F. S. Burtch, manager, wire rope sales division; C. M. Jones, vice president in charge of public and industrial relations; C. R. Tyson, president; E. C. Low, vice president in charge of sales.



George Reed receives hero's medal

For voluntarily risking his life and suffering painful injuries to save the life of a fellow worker, George Russell Reed, maintenance mechanic at the Shell Oil Company's Iowa gasoline plant, was given a distinctive honor at a reception in Lake Charles, Louisiana, recently.

The Joseph A. Holmes safety award, consisting of a framed engraved certificate with an accompanying bronze medal, was presented to the guest of honor in the presence of more than 30 Shell Oil Company officials and fellow employes by P. M. Hanahen, of the U. S. Bureau of Mines, representing the Holmes Safety Association.

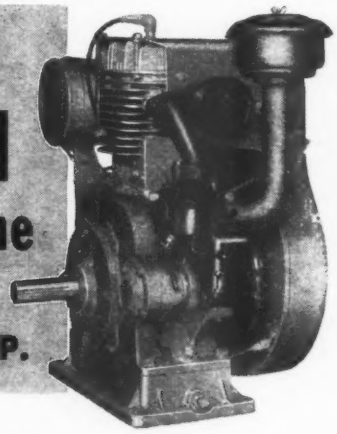
M. R. Church, assistant manager of the Shell Oil Company's gasoline division of Houston, Texas, presided at the dinner. He said the object of the Holmes Safety Award, named for the first director of the U. S. Bureau of Mines, was to honor heroism as well as to recognize outstanding safety records of individuals, industrial departments, and plants. The present occasion marked the nineteenth presentation of the Holmes award in the five states of this area, Church said.

The act of heroism for which Reed previously has been awarded the Carnegie Bronze Medal and $500 in cash, and for which he was further honored at the Lake Charles dinner, was performed November 15, 1945, at the Iowa plant, when Reed saw Raymond L. Garrett, who was engaged with Reed in painting work at the time, fall from the top of the still, a distance of 36 ft.

Reed stepped forward to catch Garrett or to break his fall, Garrett struck Reed on his head and right shoulder. Each man was knocked about 10 ft. in different directions by the impact. Had not Reed intervened, it was stated, injuries to Garrett might have proved fatal.

Among the several officials present who were introduced was E. N. Van Duzee, division manager of the Shell at Lake Charles.

This HEAVY-DUTY
WISCONSIN
Air-Cooled Engine
IS AVAILABLE IN 4
SIZES . . . 4 TO 9 H. P.



Illustrated above is the Models AEH to AHH series of 4-cycle single cylinder Wisconsin Air-Cooled Standard Engines, to which the following specifications apply:

MODEL	AEH	AFH	AGH	AHH
Bore	3"	3¼"	3½"	3⅝"
Stroke	3¼"	4"	4"	4"
Cu. in. Displ.	23	38.2	38.5	41.3
Hp. Range	4-6	5-7	6-8.5	7-9
Weight	130 lbs.	170 lbs.	175 lbs.	180 lbs.

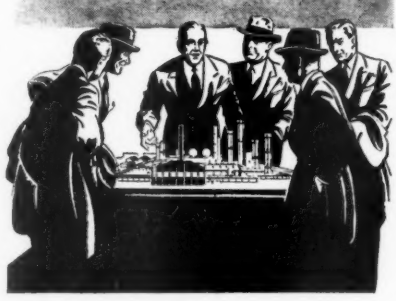
If your equipment calls for an engine within the above power range, it will pay you to give serious consideration to the Wisconsin line . . . noted for rugged, heavy-duty serviceability and thorough-going dependability.

In addition to the engines listed above Wisconsin 4-cycle single cylinder engines are also available in 2 to 4 hp. sizes, and V-type 4-cylinder engines can be supplied in a power range of 13 to 30 hp. Detailed data furnished on request.

WISCONSIN MOTOR
Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
510 Atlas Building, Tulsa, Oklahoma
M & M Building, Houston, Texas
Oil field distributors for Wisconsin Engines and all types of utility units.

GROUP
OWNERSHIP
could benefit
SMALL
REFINERS



See Page 34

Made sales manager

Arthur Zimmerman has been appointed sales manager of The Steel Improvement and Forge Company, Cleveland, Ohio, according to C. H. Smith, Jr., president. Zimmerman was formerly associated with The Weatherhead Company, Cleveland, as assistant chief engineer, and lately had been active in sales and engineering work in connection with gas turbine accessories. He is widely known throughout the aircraft industry, and has worked along sales engineering lines with many of the aircraft gas turbine manufacturers. His broad engineering experience equips him to discern quickly the nature of a parts problem and to assist the equipment manufacturer in obtaining parts that fully meet the requirements of specific service conditions.

Arthur Zimmerman

Zimmerman is a graduate of Massachusetts Institute of Technology with the degree of S. B. in mechanical engineering.

To explore Pacific Northwest

According to Reese Taylor, president of Union Oil Company of California, the company is preparing to carry on an intensive exploration program in the Pacific Northwest, where it has acquired leases on approximately 700,000 acres, about half of which, is state-owned land. Preliminary surveys have already begun on the Olympic peninsula, and President Taylor recently told a Seattle press conference that Union was ready to spend from five to ten million dollars to determine whether or not the Northwest has any profitable oil producing territory. He stated that the company was unwilling to believe the oil possibilities of the area had already been disproved, and was now engaged in an exhaustive search in the vicinities of its established market territories.

Engineering club officers

The Petroleum Engineering Club at the University of Oklahoma has elected the following new officers: President, Jack C. Owens, Miami, Oklahoma; vice president, Ray Loper, Cleveland, Oklahoma; secretary, Don D. Eley, Kingfisher, Oklahoma; treasurer, Maurice Lewis, Jr., Sayre, Oklahoma, and St. Pat's Council Representative, Pete Cawthon, Tuscaloosa, Alabama.

Student chapter A.I.M.E. elects

At a meeting held recently the Student Chapter of the AIME at Texas A&M College, College Station, Texas, elected officers to serve for the new school year.

Gene B. Caperton from Shamrock, Texas, was elected president. Gene is an old hand in the student AIME organization, having served as secretary and vice president in prewar years. William B. Gill took over the post of vice president. The secretary is Julio C. Casas, Jr., who is from Maracaibo, Venezuela. Gene M. Goodwin was elected treasurer. Professor R. L. Whiting of the Petroleum Engineering Department was chosen faculty sponsor.

Plans have been made for a very active year, during which outstanding men in the industry will speak to the club at its regular monthly meetings.

Jersey Standard directors

William Naden and H. Janney Nichols, Jr. have been named directors of the Standard Oil Company of New Jersey.

Naden, manager of the company's Employee Relations Department, joined the Colonial Beacon Oil Company in 1927 as a chemist in its Everett Refinery. Named superintendent of the refinery in 1934, he later became general superintendent of the Jersey Company's refinery at Baltimore. During the war he served as Petroleum Administrator for War in charge of refining for District No. 1. In July, 1944, he was made head of the Employee Relations Department.

Nichols, general manager of the Supply and Transportation Department, was first employed in the Development Department in 1923. Transferring to the Technical Service Division in 1927, he later served as assistant manager in 1936, becoming general manager in 1937. Appointed head of the company's Domestic Coordination Committee in 1938, he was named to head the Supply and Transportation Department in June, 1944.

Field engineer

Announcement is made by Raybestos-Manhattan, Inc., Manhattan Rubber Division, Passaic, New Jersey, of the appointment of E. L. Alderson as field engineer, oil field rubber products. Alderson has served for many years as Manhattan's sales representative in the Texas and Gulf Coast areas. He will operate as field engineer, covering all oil fields of the country. He will maintain local headquarters at Houston, Texas, but will operate from and as part of Manhattan's Product Engineering Department at its executive offices, Passaic.

ESTABLISHED 1869

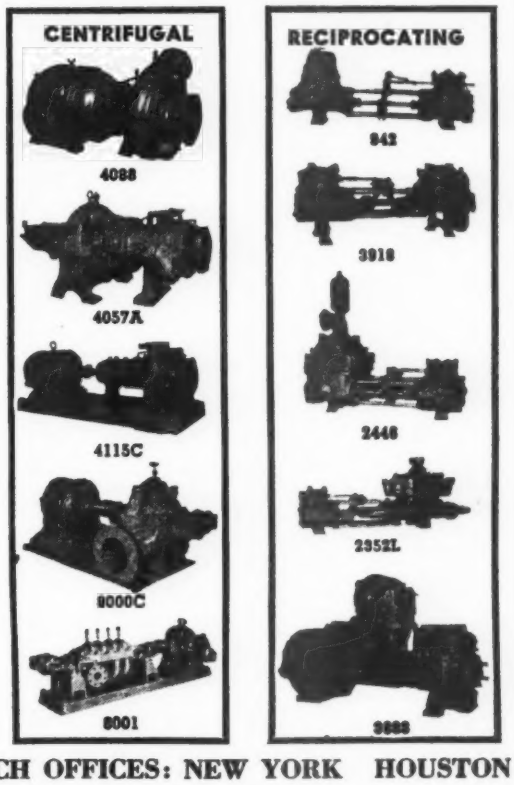
DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

323 W TENTH ST.

PUMPS

BUILDERS OF OUTSTANDING PUMPS SINCE 1869



BRANCH OFFICES: NEW YORK HOUSTON

VALUE PLUS!

Your money's worth . . . and more. That's a good thing to keep in mind when buying flanges . . . and it's what you get when you specify Phoenix Flanges. They're drop-forged . . . with all the toughness and stamina it takes for long service, safety, and downright dependability.

They're made from a mild steel that is especially suited to welding and machining and every one complies with ASA requirements and ASME and ASTM specifications. Furthermore, they're available in a wide range of styles and sizes to meet your requirements.

If you haven't already received your copy of the Phoenix Flange Catalog, write for it today . . . no charge.

Flange Division of

PHOENIX MANUFACTURING COMPANY

CATASAUQUA, PA. △ JOLIET, ILLINOIS

New officers of Instrument Society

Back row (left to right): Hugh Ferguson, treasurer; Richard Rimbach, executive secretary; J. B. McMahon, vice president. Front row (left to right): Carl Kayan, first vice president; H. Barnum, vice president; Albert F. Sperry, past president; C. O. Fairchild, president; Ralph Munch, vice president.

The First National Instrumentation Conference and Exhibit at the William Penn Hotel in Pittsburgh, September 16-20, closed with a registration of about 4000. The Instrument Society of America installed its new officers on Wednesday evening: C. O. Fairchild, president; Carl Kayan, first vice president; H. Barnum, vice president; J. B. McMahon, vice president; Ralph Munch, vice president; Hugh Ferguson, treasurer, and Richard Rimbach, executive secretary.

Plans are already begun for the next Conference and Exhibit at the Stevens Hotel, Chicago, the week of September 8, 1947.

South American petroleum convention

The central organization of the South American Petroleum Institute, and the national sections in Argentina, Bolivia, Brazil, Chile, Ecuador, Peru and Uruguay, are at this time working diligently on plans for the First South American Petroleum Convention, which will take place in the city of Lima in March, 1947.

Among the notices of interest concerning the convention is a letter from the Governor of Peru pledging his government's full support.

The official support of the Peruvian Government will unite without doubt, within a short time, the patronage of the governments of the other countries of South America.

At the Lima convention members of the petroleum industry will study, for the first time as a whole the actual situation of petroleum prospects and exploration in the South American countries.

The refining and the chemistry of petroleum will also be subjects given particular attention. Possibilities of introducing into South American refineries the technical advancements made during the war will be a special item for consideration.

The consumption, supply, exchange of fuel, as well as subjects of far-reaching importance such as relate to the legislation and economics of the petroleum industry, will be given the attention of other sections of the convention.

Ideco changes personnel

Changes in the sales personnel of International Derrick and Equipment Company have been announced by H. L. Putnam, vice president, Mid-Continent direct sales.

In the Rocky Mountain area a new sales district has been opened under the supervision of C. M. Powell. His headquarters will be at 715 Midland Savings Building, Denver, Colorado. Powell, widely known in the petroleum industry, has been with Ideco for 20 years. He was formerly at Tulsa, Oklahoma, and more recently at the Mid-Continent sales headquarters at Dallas.

Floyd E. Suder, who has been division manager for Ideco at Tulsa, has been appointed as special sales representative in charge of production equipment. Before locating at Tulsa, Suder represented the company in Kansas.

A. L. Oliver has been appointed district manager of North Texas and will remain in his present headquarters at Wichita Falls. Oliver has been in the North Texas district and supervised sales from the new Ideco supply store at Wichita Falls.

Parkersburg purchases Nowery Smith

A. Sidney Knowles, president of the Parkersburg Rig and Reel Company, Parkersburg, West Virginia, announces that his company has entered into a contract to purchase, as of November 1, the properties of the Nowery J. Smith Company of Houston, Texas, with the exception of the commercial hot-dip galvanizing business, which will be continued under the management of Tyson Smith.

It was stated that the newly acquired plant would operate as in the past with all engineering, office, and plant personnel to be retained. Upon consummation of the purchase, Nowery J. Smith will be elected vice president of The Parkersburg Rig and Reel Company and will continue in active charge of the Houston plant.

In addition to the manufacture of products heretofore made under the name of the Nowery J. Smith Company, various other products of the Parkersburg line of oil field equipment will be manufactured at the Houston plant in order to better serve the requirements of oil field customers in Texas and adjacent states, it is stated.

In charge production engineering

Sherman Miller, chief mechanical engineer of the American Locomotive Company at Schenectady, New York, since 1941, has been appointed vice president in charge of production engineering, it is announced by R. B. McColl, president of American Locomotive.

Raymond J. Finch has been appointed chief mechanical engineer.

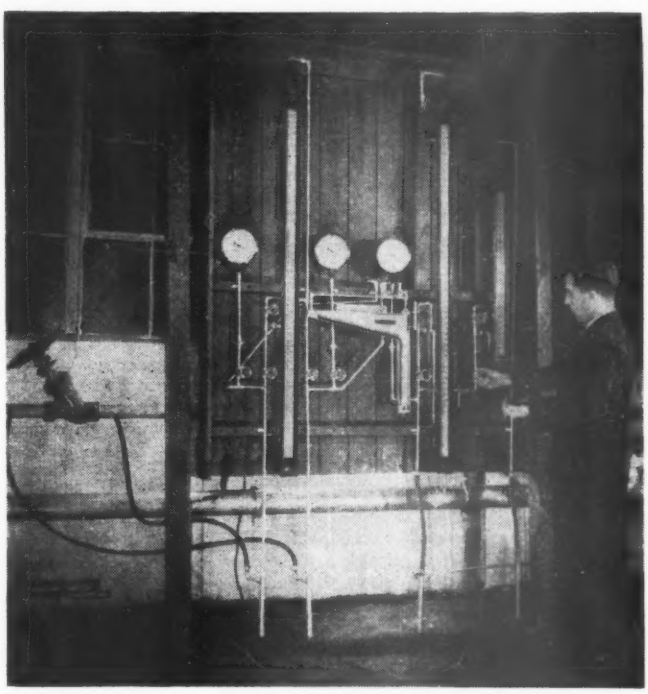
Miller will maintain headquarters at Schenectady, where he has been active since 1907. He entered the drawing room of the Schenectady plant that year and from 1916 to 1941 was superintendent of the general drawing room. Previously he had been employed in the erecting shop and drawing room of the Dunkirk, New York, plant of the American Locomotive Company.

Flow tests with unique hook-up

An original test hook-up, believed to be the only one of its kind in existence, has been constructed by the laboratories of Edward Valves, Inc., East Chicago, Indiana, for the computation of pressure losses through valves and piping.

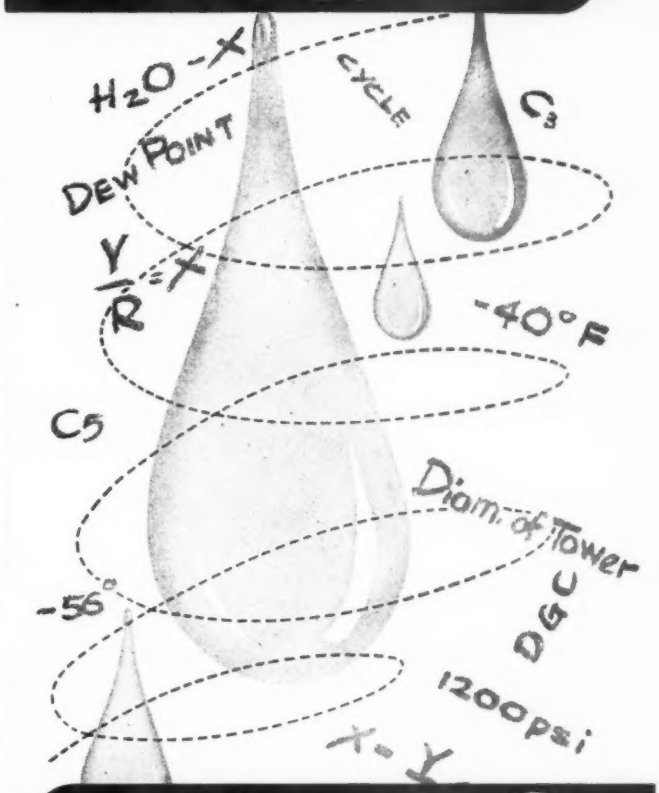
The equipment was designed and fabricated after several years of study. Provision is made, in the set-up, for tests of all types of standard valves. Readings are made on flow meters, manometers and gauges, and are tabulated for specific operating conditions. From these readings, accurate computations of pressure loss for valves of known characteristics are possible for all normal service conditions.

The experimental work on pressure loss is projected as a permanent and continuous activity of the Edward laboratories. E. B. Pool, research engineer, directs the section of the laboratory staff assigned to the project.



Recording instruments in flow test hook-up designed by laboratories of Edward Valves, Inc. Here, flow through Edward forged steel globe valve at left is measured with orifice type flow meters and pressure is checked with mercury manometers and gauges. Tests provide data on pressure loss through valves and piping, and guide design of new types of valves.

If it's a drying problem...



...work it out with DRIOCEL

Problems encountered in the drying of gases and liquids have the annoying habit of becoming process puzzles . . . taxing all the arts and sciences of the engineer. And, today's exacting requirements of low moisture content in many materials, adds to the quandary. But, to *know* how well a desiccant will perform solves much of the puzzle . . . and in many uses, under widely varying conditions, Driocel's superiority as a desiccant is performance-proved.

For instance, Driocel has exhibited a D.G.C. of approximately 10% when drying wet gas feeds presenting appreciable temperature, pressure and moisture ranges. Driocel produces dried gases of extremely low dew-point, below −57° F. What's more, its D.G.C. value is little affected by repeated regeneration. Driocel is just as efficient in the drying of hydrocarbon liquids, liquid organic chemicals, electrical oils, hydrogen, hydrogen sulfide and compressed air.

Reasons? Driocel is a "tool" built to do a job, by engineers who fully understand the function of a desiccant. It's made from selected bauxite ore, specially processed to insure high moisture adsorption and low iron content.

If you are faced with a drying problem, old or new, look into the merits of Driocel. It will perform a surprising job in most applications. And, you can be sure of sound advice on drying procedure when you write:

Attapulgus Clay Company (Exclusive Sales Agent)
Dept. J, 260 S. Broad Street, Philadelphia 1, Pa.

POROCEL

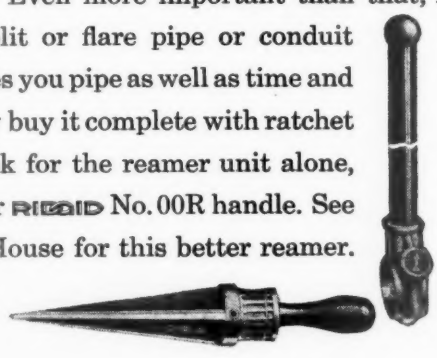
Bauxite Catalysts • Catalyst Carriers • Adsorbents and Desiccants

This extra-long taper makes your pipe reaming quick, easy and safe

RIDGID

LonGriP Pipe Reamer

● The trick of its efficient performance is in that extra long taper—it reams burr cleanly from any pipe in a few easy ratcheted strokes—practically no pressure required. Even more important than that, it won't thin, split or flare pipe or conduit wall. That saves you pipe as well as time and work. You may buy it complete with ratchet handle—or ask for the reamer unit alone, which fits your RIDGID No. 00R handle. See your Supply House for this better reamer.



Reamer unit fits RIDGID No. 00R handle.

RIDGID

WORK-SAVER PIPE TOOLS

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

On South American trip

G. M. Stewart, one of the oil industry pioneers in export sales work in South America, left Houston recently for another extended tour of South American countries for the Hunt Export Company. Stewart will represent the complete line of Hunt Tool Company products as well as those of various other manufacturers handled by Hunt Export Company. He will be in South America about three months and will make trips to Peru, Ecuador, Colombia, Trinidad, and Venezuela.

Before he joined Hunt Export Company in New York, Stewart was export manager for another oil tool manufacturer. Before entering export sales work, he was employed by major oil companies in South America and Mexico for a number of years.

Hunt Export Company also is represented in the Argentine by A. P. Bolland and in Mexico and Central America by W. Y. De Mouche.

Offices of Hunt Export Company are in New York, Houston, and Buenos Aires.

To World Trade Foundation

Dr. Courtney C. Brown, head of the Petroleum Economics Division of the Standard Oil Company (N. J.), has been appointed vice president of the World Trade Foundation of America with the responsibility of consulting in connection with research activities, it was announced by George H. Thornley, president of that organization.

"With the help of businessmen and social scientists, a Research Advisory Committee will be formed," Dr. Brown said. "This committee will review important economic research undertaken by the committee's staff affecting two-way world trade and release reports on their findings to encourage a better understanding of these problems by the public."

Previous to his present position with the Standard Oil Company, and before going into war work, Dr. Brown served as associate director of research and statistics at Chase National Bank.

During the war he served as deputy director of The Equipment Bureau of the War Production Board, vice president of the Commodity Credit Corporation in Charge of Foreign Activities and chief of the Division of War Supply and Resources of the Department of State. Last spring he served in Washington with the president's famine emergency committee, of which he is now vice chairman.

Purchase properties

Shell Oil Company, Inc., and General Petroleum Corporation have announced purchase of the properties of the Hisey Petroleum Corporation, Alliance Petroleum Corporation, and California Alliance Petroleum Corporation, in the Ventura Avenue oil field, California.

The properties consist of the Hartman Ranch, Ventura Citrus Association and Schmidt leases involving about 185 acres with nine wells producing approximately 500 bbl. a day.

New development engineer

J. C. Lungerhausen, a specialist in the design of positive displacement pumps, has joined the engineering staff of the Bowser, Inc., Industrial Pump Division, Fort Wayne, Indiana, in the capacity of chief development engineer. Lungerhausen is a graduate of Purdue University and has had many years' experience in the development of pumps and hydraulic equipment. For the last five years he has been development engineer for the Blackmer Pump Company, Grand Rapids, Michigan.

To name engineering chairman

Ernie Miller, Tide Water Associated Oil Company, Houston, Texas, has been named chairman of a committee appointed to select a successor to R. R. Kyner as field chairman of the East Texas Engineering Association.

Other members of the committee are: J. M. Cooper, Gulf Oil Corporation, Houston; L. F. Peterson, Stanolind Oil and Gas Company, Fort Worth; R. M. Hess, Shell Oil Company, Kilgore, and A. S. Rhea, Sun Oil Company, Dallas. The last two will serve as ex-officio members.

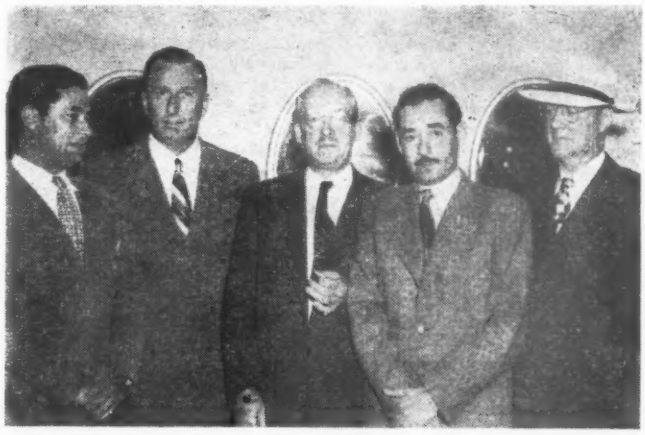
Awarded medal of merit

The Medal for Merit, highest award of the U. S. Armed Services to civilians, was conferred September 19, upon James S. Knowlson, chairman of the board and president of Stewart-Warner Corporation. The award was made by Secretary of War Robert P. Patterson at a private ceremony held in the Mayflower Hotel, Washington.

Mr. Knowlson served as a "dollar-a-year man" in various government capacities during World War II. His service, which began October 1, 1941, as Deputy Director of Priorities, Office of Production Management, included, Director of Division of Industry Operations, War Production Board, January, 1942; vice chairman combined production boards, September, 1942; Central Field Commissioner European Theatre of Operations, Army-Navy Liquidation Commission, May-September, 1945. Knowlson is at present a member of the Business Advisory Council, Department of Commerce.

Nomads hear Earl Noble

At the Mayfair Hotel, Los Angeles, some 55 Nomads gathered for the September monthly meeting, and were educated and entertained by Earl B. Noble, who presented a film in technicolor covering his recent travels in Paraguay. Earl is manager of exploration for Union Oil Company of California; president of the American Association of Petroleum Geologists, and a motion picture photographer to boot.



At the Nomads meeting were, left to right: Juan Pedretti, vice consul of Paraguay; Bus Hayes, International Petroleum Company, Talare, Peru; J. W. Bradley, Mene Grande Oil Company, Caracas, Venezuela; Dr. Pedro Abreu, Venezuelan consul, Los Angeles, and Earl B. Noble, Union Oil Company of California.

His film, which was supplemented by interesting comment as it unrolled, took in the entire gamut of operations in Paraguay, from the landing of equipment at Puerto Casado on the Paraguay River, to road building, camp installations, seismograph crews at work, and finally the spudding of Santa Rosa No. 1, Paraguay's first well.

The colorful spudding ceremony was attended by a number of high officials in the Paraguayan Government, as well as several Union Oil Company executives. The film caught not only the excitement over an entirely novel event in the history of the Chaco, but gave a fine impression, also, of the nature of the terrain, the difficulties imposed by distance and lack of roads, and something of the modus of living in the isolated area in which the well is located.

Tretolite desalting headquarters moved

The Tretolite Company has moved its desalting department headquarters from Houston, Texas, to St. Louis, Missouri. This move has been made in an effort to broaden the services available to the industry in desalting, demulsifying, and affiliated activities. In recent years Tretolite service has been expanded to include consultation, research, and commercial applications of water clarification chemicals, pour point depressants, surface tension depressants, inhibitors for use in acid treatments and demulsifiers and foam preventers for use in doctor treating and other sweetening solutions.

In recent months the Tretolite service personnel has been expanded and process engineers are now situated in all the key sections of the country. Service is also available to Canadian and Latin American refiners and producers.

The Tretolite Company is in a better position now than ever before to assist refiners with special desalting, demulsifying, and clarification problems, company officials announced. Requests for service or information along these lines should be directed to the Tretolite Company, Refining Department, 937 Pacific Avenue, St. Louis 19, Missouri, it is pointed out.

Alexander general sales manager

Tom E. Alexander, former southern sales manager for Larkin Packer Company, Inc., was named general sales manager of the company recently. W. H. Larkin, president, announced.

Alexander will continue to make his headquarters at Larkin's Houston, Texas, office, it was said.

Alexander joined the Larkin organization more than nine years ago as salesman in the Corpus Christi area. He was moved to Houston as city salesman and was named southern sales manager in 1941.

Tom E. Alexander

Alexander began his oil industry career in the fields of Texas. Before he joined the Larkin organization, he was with Wynne Drilling Company. His oil-industry experience covers both field and sales work in the Gulf Coast, Mid-Continent, and foreign fields. He worked in Aruba for Lago Oil and Transport Company from 1929-31.

Selections from the

"Most Complete Line of Tongs in the World"

PETOL TOOLS — TITAN TOOLS

28 TYPES
A TYPE FOR EVERY PURPOSE

290 SIZES
A SIZE FOR EVERY REQUIREMENT

PETOL TUBING TONGS

PETOL SUCKEROD WRENCH

Type A *Type B* *Type C*

TITAN CATLINE SWIVEL

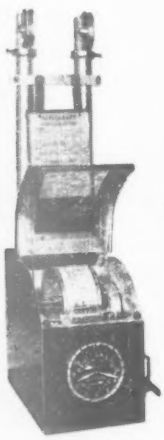
WRITE FOR CATALOG NO. 50
for full details on all
PETOL AND TITAN PRODUCTS

GEARENCH MFG. COMPANY
HOUSTON, TEXAS, U.S.A.
EXPORT: 74 Trinity Place, New York, N. Y.

FOR ACCURATE DRILLING TIME DATA

GEOLOGRAPH MECHANICAL WELL LOGGING SERVICE

Among numerous favorable comments of drilling contractors and oil companies, we quote from Chester H. Westfall, president of Mercury Drilling Company:



"The Geologograph record speaks for itself!"

"For one thing, until the Geologograph became available, we had found no way to keep a record of lost time that we knew was accurate and complete. Now, it is easy for driller or toolpusher to note on the Geologograph log opposite each non-hole-making period the reason therefor. Such summary of lost time is enlightening both to the office and the field."

"We have found that good drillers very much appreciate good records. The Geologograph takes the 'other guy's' alibi out of the daily report. It takes a lot of the 'guess' out of making holes and makes good drillers better ones."

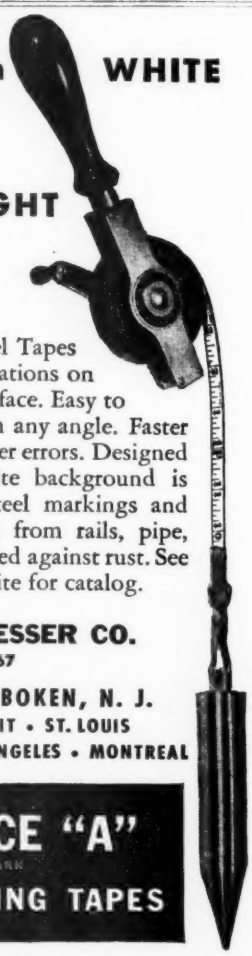
Reasonable rental rates. Write for details now.

"TIME WILL TELL"

THE GEOLOGRAPH CO.

25 North Western — Oklahoma City 4, Oklahoma

BLACK on WHITE for BETTER SIGHT



WYTEFACE "A" Steel Tapes have *raised* black graduations on a crack-proof white surface. Easy to read in any light, from any angle. Faster measurements with fewer errors. Designed for hard service. White background is protected by raised steel markings and rims. Resists abrasion from rails, pipe, rocks, concrete. Protected against rust. See your supply house. Write for catalog.

KEUFFEL & ESSER CO.
EST. 1867

NEW YORK • HOBOKEN, N. J.
CHICAGO • DETROIT • ST. LOUIS
SAN FRANCISCO • LOS ANGELES • MONTREAL

K+E

Drafting Reproduction Surveying Equipment and Materials Slide Rules Measuring Tapes

WYTEFACE "A"
TRADEMARK
STEEL GAUGING TAPES

Pacific Personalities

Rollin Eckis, Richfield's chief geologist, is not only interested in the discovery of new oil reservoirs, but will go a long way to find a nice trout pool. When he and Frank McPhillips of the land department, returned some time ago from an expedition, Jimmy West asked Rollin, "How many did you catch?" "Lemme see," replied Rollin, looking at Frank, "How many was it we agreed on again?" Frank, by the way, is also addicted to big game hunting, and is our authority for the statement that hunters of the Canadian northwoods are the most inarticulate people in the world. Some of them only open their traps once in a whole winter.

●

We hear tell that on a certain day not long ago, Russ Havenstrite was just stepping aboard his plane to hie to Alaska about the same time that Glenn Johnson was stepping aboard his chariot to scram to the High Sierras for a much needed vacation. Just at that moment, came news that a well in the Del Valle field had blown in, and was in need of expert and urgent attention. The two travelers immediately changed their plans, and jointly tackled the problem of the unruly well. After a hard fought battle they had it thoroughly subdued, and Russ was so sorry for upsetting Glenn's vacation arrangements that he invited him to come on along to Alaska, which he did. At last reports they were both up there cavorting with the Eskimos, while the Johnson limousine was still standing in Los Angeles, loaded to the gunwales for a mountain vacation.

●

Many years ago, we attended a stag party at the Hollywood Athletic Club for a young petroleum research chemist who was about to be married. Our particular buddy on that occasion was Claude "Speedo" Swift, Union's patent attorney. The affair was all perfectly well behaved until one adventurer in atomic energy emptied something into the punch that must have been on the verge of fissioning. In any case, from that moment, Speedo and we spent our time gathering the fallen braves and taking them out to their respective wagons. When we would go back for more, the ones we had already convoyed would come out again, and the gray dawn was breaking loudly before we had them all on their ways to some place or other. It was an occasion we never forget to recall when we meet now, and we have enjoyed many a chuckle over it. All of which leads up to another interesting occurrence reported by one of our harbor operatives a few days ago: Hugh Multer walked into Speedo's office recently, and without any remark quietly laid a book on his desk. They chatted for a short time and then parted, whereupon Speedo picked up the book and started to thumb through it. You could have knocked him over with an unsaturated hydrocarbon when he found that Multer was simply returning a volume he had borrowed thirty years ago, when they were both attending college together.

●

We had a brief note from Jules Toussaint recently in which among other things he discussed the origin of various botanical specimens in a manner that showed a deep insight into the subject. We will be glad to supply the particulars anytime we can see you alone, unless in the meantime you can get the lecture firsthand from Jules himself. Further news from up in the Bay region indicates that Kelly Kimbrall, head of the Shell Camera Club at Martinez, is now known as Snapper Kimbrall. He dashed into a photo supply shop in Oakland the other day, if we can believe what we hear, and asked the clerk for some film. "Fast or slow?" the latter enquired. "Which is the most expensive?" Kelly further asked before committing himself. "Fast," said the clerk, and was promptly told, "Oh, well, just give me the slow—I'm in no hurry."

●

Bill Bettis, prexy of the Los Angeles Nomads, tried an amazing experiment at the summer Wing Ding this year when he appointed Lee Laird, the well known Scot, in charge of prizes. Bill no doubt felt that Lee's native thrift would enable him to purchase many more prizes than usual at a much lower cost than usual, and thus break the black market in pewter mugs. From what we hear, the experiment worked out all right. The party was a huge financial success, and there is now loud talk of forming a national prize-purchasing commission with Lee as chairman.

●

From one of our field scouts comes a sudden report that Mr. and Mrs. Bill Bettis and Mr. and Mrs. John Flanagan of M. O. Johnston Company, left Los Angeles for Mexico City on Sunday, September 22, by plane, on a jaunt that will combine business and pleasure. Bill Bettis, twice president of Los Angeles Nomads, in his spare moments does a swell job for the Boy Scouts of America. He has so long been teaching his troop the fundamentals of petroleum production, that any one of the boys could do an interesting paper for the A.P.I. John Flanagan is a golfer, so his big excitement is the earth movement.

that is, the movement of sizeable pieces of it from one place to another by means of an eight iron, or some other equally appropriate implement. Be all that as it may, we understand that John is on his way to South America, and Bill will return to Los Angeles, after seeing him safely on his way.

●

Ralph Marshall of Drilling and Exploration Company has just returned, as we write, from a somewhat hectic but nonetheless interesting trip down into South America. Besides following the route of the equipment that he has been sending down to Paraguay for use in the Union Oil Company operations, he visited several other Latin-American countries, and was vastly intrigued by what he saw. We have forgotten just where he was when he noted some ladies walking very erect along the street, each balancing on her head a five-gallon gasoline can of water, and showing not the slightest distress in manipulating the load. On the contrary, he was greatly impressed by the dignity of their bearing, and the grace of their motion. One, who particularly attracted him, carried a can that leaked at the corner. Undisturbed by this circumstance, she glided smoothly along, holding a gourd under the leak, and at intervals emptying it back into the can, without ever missing a step.

●

While we are speaking of distant parts, we are reminded that Ted Miles, former manager of foreign operations for Union, has accepted the professorship of petroleum engineering at University of Southern California, and is now carrying on where John Dodge, Pantepec vice president, long held sway. Ted should do a grand job, as he has a rare faculty for elucidation, and this combined with a fine academic training and lots of worthwhile experience should equip him admirably to develop "the young idea." Ted also possesses a nice turn of humor, is a voracious reader, and a keen observer, all of which makes him a very interesting conversationalist. Get him started some time on the characters he has bumped into while traveling in the remoter regions of California and he will give you an entertaining time. We remember one of his proteges, who had looked after a little pumping job back in the hills so meticulously and so long that he was even out of touch with ordinary phraseology, and was consequently obliged to manufacture his own. A sample of his literary confection was the phrase, "as hard as the back of God's head," which he tacked to anyone who seemed to be uncommonly lacking in sympathy.

●

Now, we understand from the gas measuring lads that Senor Vergil Schultz makes an occasional flying visit to Los Angeles from Mexico City, mostly to get a little practice in speaking English, but also to get another gulp or two of the climate on which he subsisted for so long. Another morsel of gossip straight from the metering department is that Gordon Greene, after many years with the Robinson Orifice Fitting Company, resigned a while ago and is now with Electric Steel Foundry Company. It is a long time since we first started meeting Gordon at the various oil men's functions, but we distinctly remember that the contact always made these functions just a little bit more enjoyable. Gordon and Mrs. Greene vacationed up in the Northwest a while ago, and a mutual friend, who shall be nameless, swears that Gordon, sent him a wire from Seattle, reading "Having a swell time. Wish I could afford it."

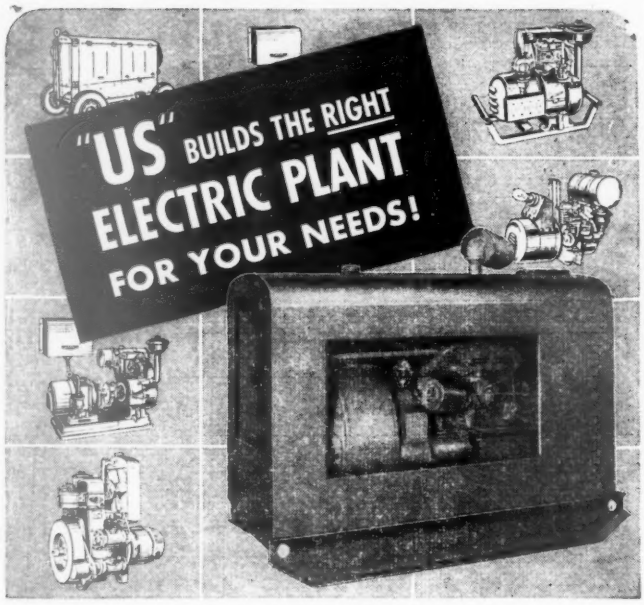
●

Back from a fishing trip in Utah comes Jim Moon with a picture of himself holding a trout that is big enough to be suffering from elephantiasis. Everything was lovely on this jaunt, according to our Utah reporter, except that Jim was crossing a stream on stepping stones at a very shallow point and slipped off a stone. Before he had quite recovered from his astonishment he sank to his waist in the blackest, ooziest mud so far discovered on the American Continent. By dint of much wiggling and weaving he eventually managed to extricate himself from a very precarious situation, and found that his case could be best treated by standing in the water stream and allowing the current to carry off the mud that clung affectionately to his jeans. That part of the process worked like a charm, but a few minutes later when he stooped to wash his hands, his wallet dropped out of his upper pocket and floated swiftly downstream, with Jim floundering after it. He finally caught up with the wallet, bent over to pick it up, and—out fell his watch. The story from here on is too terrible to repeat.

●

While in piscatorial humor, we might mention that Lee Cheever of Southern Counties Gas Company, and president of Southern California Meter Association, some time ago invited the executive officers of the association to a fishing trip aboard his yacht, the S. S. Orifice. Accounts of the excursion are a bit garbled, but it appears that the three takers—Jake Groenewegen, Charlie Meriam, and George Stevenson—by some miraculous dispensation managed to get back home with no fish, some conflicting stories, and very red faces. As nearly as can be gathered, the quartet trawled all waters between Balboa and the Gulf of Mexico, not excluding the Island of Catalina where they caught a few sly winks, and were nearly caught themselves by a monstrous bass that gobbled up Charlie Meriam's fishing rod and was looking around for some dessert when the Waltonians decided to make themselves scarce.

ANNOUNCING
SPECIAL
TRAIN SERVICE
TO
CHICAGO
FOR THE
A·P·I
AMERICAN PETROLEUM INSTITUTE
CONVENTION
NOV. 10-15
1946
Katy Special train will leave Dallas at 5:00 p. m. (Highland Park at 5:15 p. m.) Saturday, November 9, 1946, immediately after the Texas A & M vs. S. M. U. football game. Special A. P. I. sleeping cars from South Texas points will join the train at Dallas.
For further information and reservations, contact
MAX P. CURTIS, D. P. A.
1303 Commerce St., Dallas,
or your local
KATY REPRESENTATIVE
M·K·T
KATY RAILROAD
MISSOURI-KANSAS-TEXAS
415
MISSOURI-KANSAS-TEXAS RAILROAD SYSTEM



"U. S." builds a dependable Electric Plant to fit every oil-field use . . . compact portables for emergency use . . . units in weather-proof housings . . . automatic units for camp lighting. AC and DC units—gasoline, diesel, and for operation on natural gas. Write for information.

DISTRIBUTORS: U. S. Electric Plants, 7001 S. San Pedro St., Los Angeles 3, Calif.—Southwest Equip. Co., 919 So. Ervay, Dallas 1, & Kilgore, Texas—C. A. McDade Co., 6526 Hamilton Ave., Pittsburgh 6, Pa.—Midland Implement Co., Box 2113, Billings, Mont., & Great Falls.

UNITED STATES MOTORS CORP.
547 Nebraska St. Oshkosh, Wis.

Safe - Thrifty

FOCAL RAY EMPIRE

OIL FIELD LANTERNS

(MODEL 940 UL)

●SPARKPROOF construction throughout. Light socket ejects broken bulbs. Wide adjusting range—from beam to floodlight at turn of lens. Flexible Directional Beam. Wireless Sliding Switch. Easy Grip Handle. Runs on 6-Volt Lantern Battery. ● *At Your Supply Distributor, or write for immediate delivery.*

$4.00 LIST PRICE

Listed and Approved by Underwriters' Lab., Inc. Report No. E14729.

THE METAL WARE CORP. TWO RIVERS, WISCONSIN

SUBSCRIPTION ORDER FORM

The Petroleum Engineer,
Box 1589, Dallas, Texas.

(Enter) (Renew) my subscription for—
1 year $2.00 ☐ 2 years $3.00 ☐

*Name*_____

*Company*_____

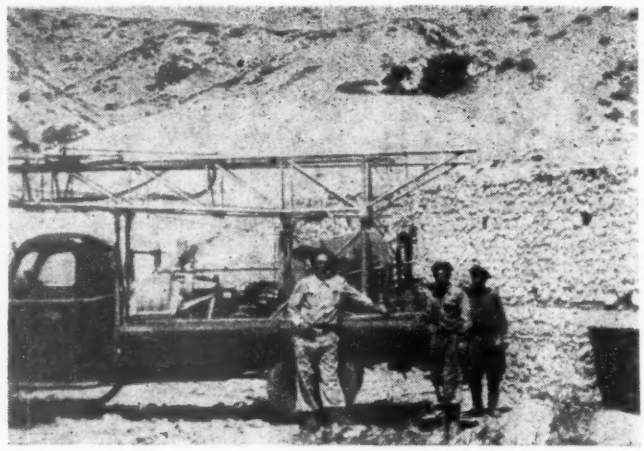
*Position*_____

*Home Address*_____
(or)
*Office Address*_____

*City*_____ *State*_____

American Equipment in Eurasia

American-made drilling and exploration equipment, operated by native crews, is beginning to appear again in foreign countries. Pictured here is a Failing Model 1500 Holemaster drill parked in front



of a buried city in Eurasia. (Censorship restrictions imposed on the American who took the picture prevent naming the country in which the drill is operating).

The work of excavating the buried city was halted during the war years but plans have been made to resume it in the near future, according to word received by the Failing company.

Among the foreign countries to which the Failing company recently has shipped drilling equipment are Turkey, India, Sweden, and South America.

George Michel retired by BJ

The Oil Tool Division of Byron Jackson Company, Los Angeles, announces that George X. Michel of its California sales organization has been retired on a special pension because of complete physical breakdown.

Michel, aged 56, was born in Van Buren, Arkansas. He served in the first World War as a lieutenant in the Air Corps, being one of the first graduates of Taliaferro Field, Texas.

Michel was active in the booms of Ranger, Burkburnett, Borger, and other Texas and Oklahoma fields before going to California at the height of the flush days of Signal Hill where he joined the Goodman Drilling Company as a superintendent.

In 1930 Michel joined the U. S. Tool and in 1935 its successor, BJ Oil Tools. He represented BJ in Bakersfield until 1944 when he was moved to Ventura in interest of his health. He continued to serve BJ until his retirement August 1 of this year.

API train accommodations

The American Petroleum Institute's annual convention in Chicago next month, being the first postwar meeting of the national body, is expected to have one of its greatest attendances in history. Railroads operating between the oil areas and Chicago, consequently, have arranged for special accommodations to transport delegates.

Routed via Texas & Pacific, Missouri Pacific, and Alton railroads, extra sleepers will be operated from Fort Worth and Dallas, Texas, through to Chicago, leaving Fort Worth at 4:50 p.m. and Dallas at 5:45 p.m. November 9, arriving in Chicago at 5:15 p.m. November 10.

As many delegates will desire to attend the Southern Methodist University-Texas A. & M. football game, to be played in the Cotton Bowl, Dallas, beginning at 2 p.m., special sleepers will also be placed at the Fair Grounds, opened for occupancy at 1 p.m. Passengers attending the game may deposit their baggage in their sleeper before game time, and return to the car immediately after the game. These sleepers will leave Fair Grounds at 5:45 p.m., by special switch to the main line junction where they will be attached to the regular train, which also leaves the Union Station at 5:45 p.m.

The lowest round-trip rates from practically all points in North, West, Central, and South Texas to Chicago apply via Dallas, and delegates from Houston, San Antonio, Austin, and other South Texas points who desire to attend the Southern Methodist University-Texas A. & M. game, may have their tickets routed, via going trip, via Dallas, thence T&P-MP-Alton to Chicago, returning direct through St. Louis and Longview, if they so desire, at no extra cost.

Delegates from West Texas who desire to attend the game may use regular equipment on T&P No. 8, arriving Dallas at 7:50 a.m., November 9, and reservations will be made for them in the special sleepers departing from Fair Grounds at 5:45 p.m. same date.

Those desiring this service from Fort Worth or Dallas, who do not care to attend the game, should so advise when requesting reservations and they will be assigned space in the other Chicago sleepers, which will leave from the Fort Worth and Dallas passenger stations.

Book Reviews

Manual of Design for Arc Welded Steel Structures. *Published by Air Reduction Sales Company, 60 East 42nd Street, New York 17, New York. Pages, 285. Price, $2.00.*

The manual was prepared with a view to making available a comprehensive source of up-to-date information that will facilitate the rapid design of welded steel structures and to provide a suitable supplementary text for engineering students.

Although many features of the book, such as standardized beam connections, and many of the details of the design that are illustrated, have been compiled particularly for use in building construction, nevertheless many of the design diagrams and fundamental principles may be applied to the design and engineering control of other types of welded steel construction.

Compiled by LaMotte Grover, a member of the American Society of Civil Engineers and well known in the field of structural welding, the methods and procedures that are presented are based chiefly upon standards of the American Welding Society, the 1946 edition of Specifications of the American Institute of Steel Construction, and reports of Welding Research Council's Structural Steel Committee.

• **Hydrofluoric Acid Alkylation.** *Published by Phillips Petroleum Company, Chemical Products Department, Bartlesville, Oklahoma. Price, $7.50 per copy.*

This volume represents a complete up-to-date compilation of a series of "Blue Books" that were distributed to a restricted group of individuals approved by the Petroleum Administration for War. The Blue Book reports covered operating experience, pilot plant, research, and metallurgical investigations at HF alkylation units.

With wartime secrecy requirements lifted, the book makes information concerning the HF alkylation process available to all. It explains in detail the operation of the HF alkylation process for the manufacture of aviation gasoline. It also describes the equipment used and operating experience gained during the wartime development of commercial scale alkylation in the oil industry using liquid hydrofluoric acid as the catalyst.

Numerous graphs and figures together with processing and laboratory facts are included in order to make the data more valuable to engineers and others interested in the HF alkylation operation.

• **Oil and Petroleum Year Book, 1946.** *Published by Walter E. Skinner, 20 Copthall Avenue, London E. C. 2. Price, 15s 0d. net, and 16s 0d. post free abroad.*

The 1946 edition is the 37th year of issue of this standard reference work compiled by Walter E. Skinner. Complete and up-to-date particulars are given concerning 566 companies covering all branches of the oil industry, both American and foreign companies.

The particulars of each company comprise names of directors and other officials, seat of operations, description of business and crude oil production, details of capital, dividends, and financial results. Other useful features are the names and addresses of 260 managers and engineers and the names of the companies in the book with which they are connected, and a Buyers' Guide of Manufacturers of oil field and refinery equipment, comprising 400 headings.

• **Review of Petroleum Geology in 1945,** *by F. M. Van Tuyl and W. S. Levings. Published by Department of Publications, Colorado School of Mines, Golden, Colorado. Pages, 203. Price, $2.00.*

The *Review of Petroleum Geology in 1945* is available for distribution as Volume 41, No. 3, of the *Quarterly* of the Colorado School of Mines, H. M. Crain, director of publications at the school, has announced. This is the fourth such review published annually in the *Quarterly* in cooperation with the AAPG.

The authors are Dr. F. M. Van Tuyl and Prof. W. S. Levings of the department of geology with members of the faculty of the departments of geology, geophysics, and petroleum engineering. Both American and foreign geologists, geophysicists, and petroleum engineers have also contributed to the review, so that both the domestic and foreign fields are more broadly treated than in previous reviews.

The publication includes a bibliography of about 1500 listings.

• **Scientific Instruments.** *Edited by Herbert J. Cooper. Published by Chemical Publishing Company, Inc., Brooklyn 2, New York. Price, $6.00. Pages, 304.*

This book discusses a wide range of instruments designed for making physical measurements. Not only laboratory instruments but also those used in the field, in industry and commerce are well covered. In addition to the description of the various instruments, much space is devoted to the discussion of the principles on which they are based and to methods of measurement. Fifteen specialists and many large firms and organizations contributed to this comprehensive volume, which should prove of great help to everyone who uses scientific instruments in his profession or studies.

Facts, Figures and PROOF

That's what you'll get when you inquire about Jensen Pumping Units. Just like the unit itself, the facts are clear, honest and straightforward. No fancy frills or wild claims. You'll get proof that a Jensen is ruggedly built to pump oil as long as it's there, for a reasonable and economical price.

The best way to get your facts, figures and proof is to talk to Jensen users or your Jensen dealer or write us. You'll be glad you did.

JENSEN
BROTHERS MFG. CO.
Coffeyville, Kansas, U. S. A.
Export Office: 50 CHURCH STREET, NEW YORK CITY

PEERLESS
(Formerly Dayton-Dowd)
Horizontal Centrifugal PUMPS

General Service
Continuous Duty
A Wide Range of Sizes and Capacities
Up to 60,000 G.P.M.

Peerless Type "A" Split Case
Capacities up to 60,000 g.p.m. Single Stage—Double Suction. Embodies most advanced hydraulic design and efficiencies. Ball Bearing Type.

Effectively used in all types of industries where high-grade pumping is needed under stress of pressures and high temperatures. Peerless Centrifugal pumps can be furnished in other than standard specification metals and dimensions for specific pumping problems.

PEERLESS PUMPS

Learn of the many advantages gained when you pump with a Peerless. Write Today.

PEERLESS PUMP DIVISION
FOOD MACHINERY CORPORATION
Canton 6, Ohio • Quincy, Illinois • Los Angeles 31, California
DISTRIBUTORS IN ALL PRINCIPAL CITIES